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A Flying-Boat that Sheds Its Wings

Changing from bird to fish if compelled to alight at sea

WHEN you fly to New York from England across the Atlantic ocean, everything depends on the engines. So long as they run you skim the clouds in safety. If they stop, down you must glide to the sea. Motion is the secret of an airplane flight—incessant motion.

Do you remember Hawker's mishap? Do you remember how nearly he lost his life in a heavy sea, because a passing tramp steamer found it difficult to reach him? To be sure, his was a land machine—doomed if ever it was compelled to alight on the heaving billows.

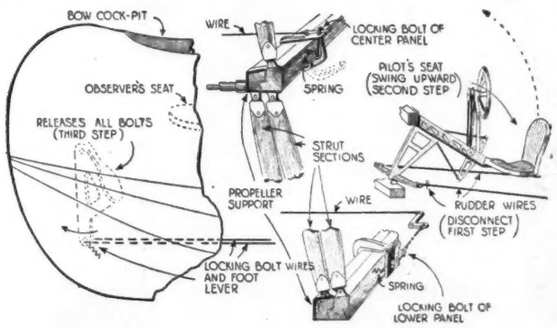
The transatlantic airplane of the future will probably be a flying-boat. If its engines fail, it will alight on the surface of the water and float. The wings will then become a handicap, particularly in a storm. A sailing ship in a storm scuds along, either close reefed or under bare poles. The enormous expanse of wing of a flying-boat as it floats may imperil the passengers. Why not shed them altogether? That is the solution proposed by Mr. Glenn H. Curtiss and one of his engineers, Mr. William L. Gilmore.

Examine the accompanying drawings and you will see how Mr. Curtiss and Mr. Gilmore could rid a flying-boat of its useless wings.

In the first place, there is a very staunch, seaworthy hull, provided with bulkheads and water-tight compartments. In that hull an engine is mounted which drives aerial propellers; there is also an auxiliary engine, which drives a water propeller.

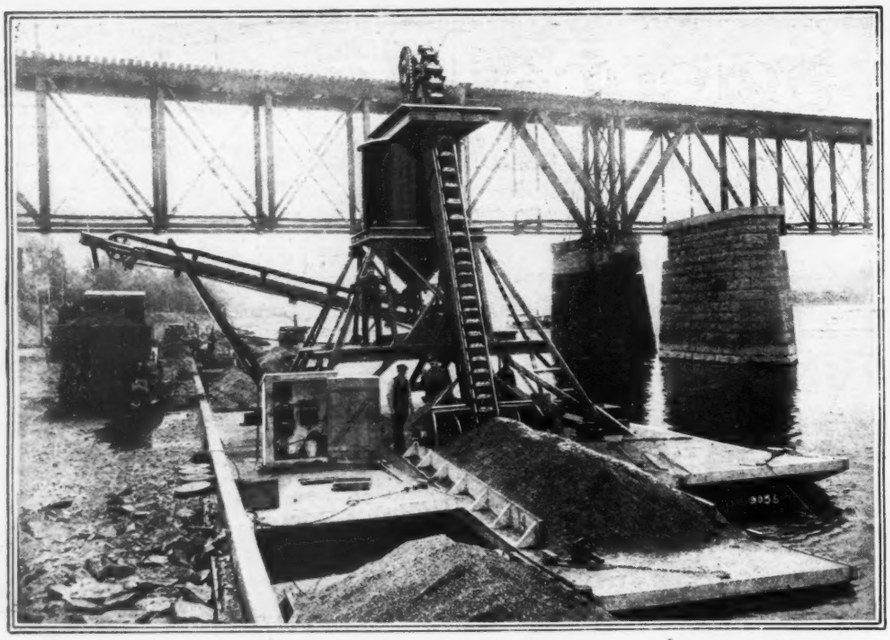
The wing structure to be shed consists of a triplane, secured to the back of the hull by means of a saddle. Pull a lever and the saddle is released so that the wings and outrigged tail (supported from the wing cell only) slides back on rails from the stern of the boat.

The wings are to be shed with the aid of the aerial propellers. But suppose the engine is dead? The wings can nevertheless slide back because of the inclination of the trackway and the propulsive effort derived through the water propeller. The wind literally blows the entire wing structure away when it is released, leaving the boat free to ride the storm.



To shed the wings the pilot in the rear cockpit disconnects the rudder wires, pulls up the wing controls and pilot's seat to a position above deck, and climbs to a position of safety. The observer forward unfastens the holding bolts and the wind from the propellers blows the wings overboard

Changing from bird to fish in mid-ocean is the work of only a few minutes for this biplane



The flat coal-boat is slid in between two floats having a chain-and-bucket elevator; the coal is carried to a storage bin above and fed to a belt conveyer running to shore

Mining Coal from the Bottom of a River

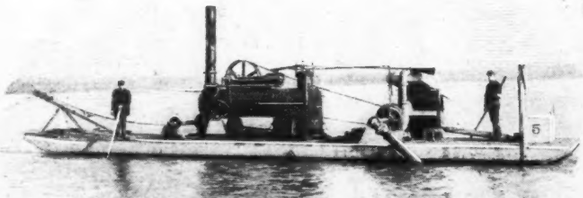
IN the anthracite coal regions of Pennsylvania, a great deal of fine coal from the culm banks is washed down the streams at times of flood, forming extensive beds of coal. This fine coal can, with modern methods of combustion, be used very satisfactorily in steam plants.

Along the Susquehanna River coal fleets are very much in evidence; long flat boats with stern wheels, for navigating the shallow waters, move the dredges and coal-boats. Each dredge, as shown in the illustration at the right, is equipped with a horizontal engine and boiler which drives a rotary pump that sucks the coal up from the bottom of the river.

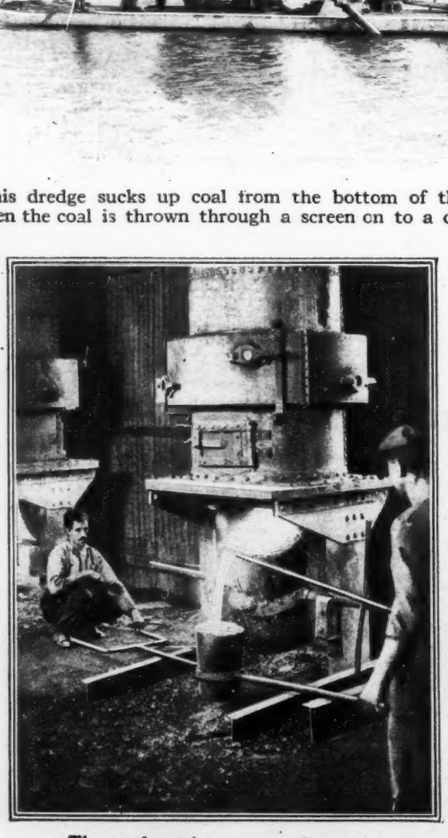
The coal is discharged against a screen through which the water and most of the sand passes, and is then dropped into a coal-boat tied alongside. The engine also drives a windlass at the bow of the dredge, which slowly winds up the long anchor rope so as to drag the head of the suction pipe slowly over the bed of coal.

When the coal-boat is taken to shore, it is unloaded by a chain-and-bucket elevator with a feeder at the lower end. This feeder sweeps up the coal across practically the whole width of the boat, so that very little is left to be cleaned up by hand. The machine will unload the coal at the rate of a ton a minute.

The elevator delivers the coal to an overhead steel storage bin from which it is fed to a belt conveyer running over to shore.



This dredge sucks up coal from the bottom of the river; then the coal is thrown through a screen on to a coal-boat



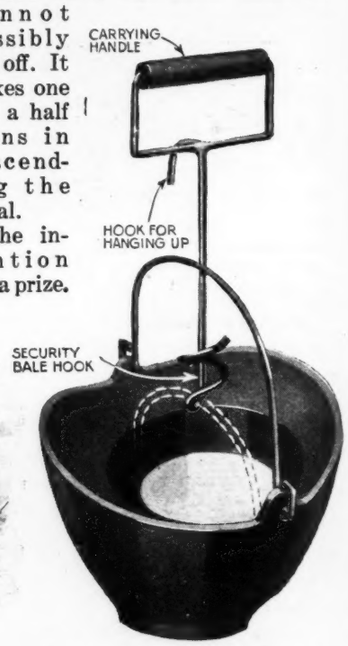
The molten iron pours from the furnace to a large bucket which tilts the liquid into a smaller one

A Hook that Holds the Solder-Pot Securely

"LOOK out!" shouted one of the linemen who were occupied with a soldering job. The next moment the solder-pot upset, and the man who was holding it narrowly escaped a bad burn.

William Nieswinter, a foreman in the employ of the Commonwealth Edison Company of Chicago, saw this incident happen so often that he devised the safety pot-hook shown in the picture. The hook part is made in the form of a spiral. The weight of the pot carries the bale to the bottom turn, and once there it cannot possibly slip off. It makes one and a half turns in descending the spiral.

The invention won a prize.



This safety-first pot-hook is designed to prevent burns from overturned solder-pots

The New Iron Bucket

WHICH is the most efficient way of getting molten iron from the furnace into molds? Many ways have been tried, but few survive. One of the chosen few is illustrated at the left. A small part of the bottom of the furnace drops out and the iron pours into a large bucket beneath it.

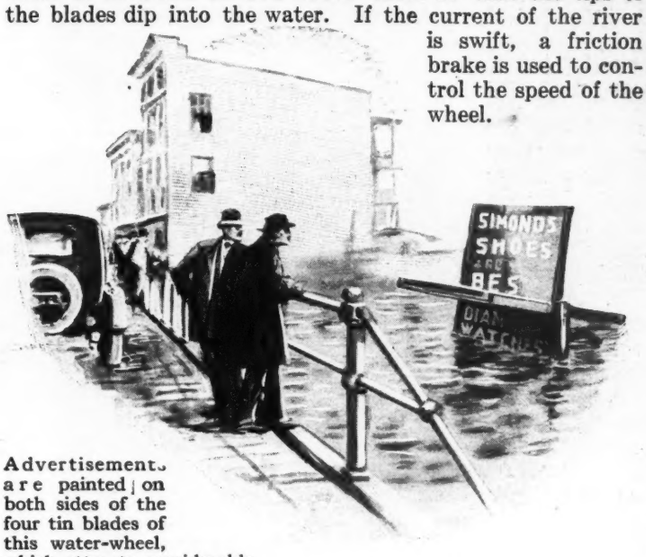
The bucket is mounted on a shaft that can be made to revolve; thus the bucket is easily tilted. A small bucket is placed in front of the large one and the iron is poured from the large to the small. The men carry away the small bucket, fill the molds from it, and by the time they get back the large bucket is full again. Two men are thus able to fill the molds rapidly and the process is continuous.

In most furnaces, when the bucket is full the flow must be turned off until another empty bucket is placed under the spout.

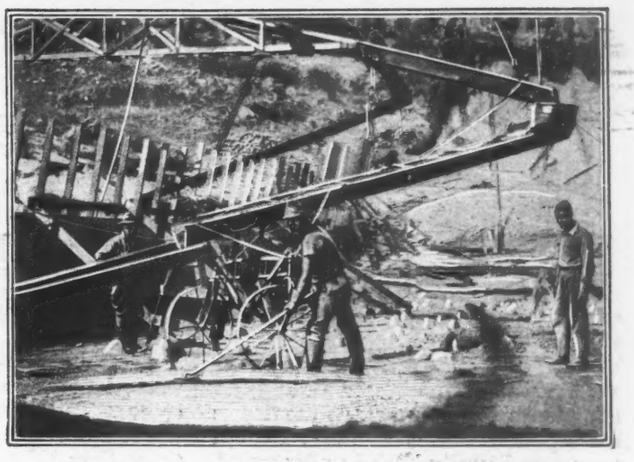
Advertisements on a Water-Wheel

THE water-wheel has gone into the advertising business and finds the work much easier than furnishing power to machinery. Advertisements are painted on both sides of each blade. The wheel turns over—propelled by the current of the river—and the wet advertisements shimmer forth in turn, so that all who pass may read.

Four posts are driven into the river-bed, and the water-wheel is mounted on and above them so that the tips of the blades dip into the water. If the current of the river is swift, a friction brake is used to control the speed of the wheel.



Advertisements are painted on both sides of the four tin blades of this water-wheel, which attracts considerable attention from passers-by



The end of a concrete chute is mounted on a bicycle so that it can be pushed into any position desired

A Concrete Chute on a Bicycle

A CONCRETE chute goes for a bicycle ride! Sounds strange, doesn't it? But consider the problems with which a concrete chute is confronted. It must move its delivery end from place to place as the work progresses. Why not use a bicycle for the job?

This scheme was put into effect in the construction of the Gibraltar dam, near Santa Barbara, Cal. The two wheels were taken from an old buggy and were mounted on a frame made up of scrap iron and odd pieces of old pipe. The chute was fastened to the frame. The wheels were bolted so that they could be turned in any direction desired.

When the workmen wished to move the chute they simply turned the wheels to suit and pushed the bicycle by hand.

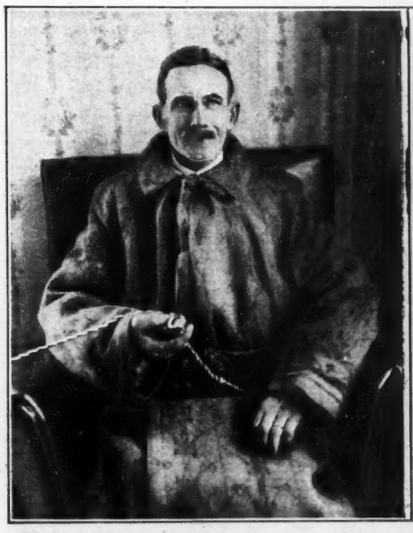
Wire Your Bathrobe and Keep Well

"IT'S cold!" you chatter as you come home worn out from a hard day's work. What you need is invigorating treatment, and you may easily obtain it by putting on an electrically heated bathrobe.

Such a robe has copper wire woven in with the cloth so that no two sections touch each other, thus preventing short circuit when the wire is connected to an electric circuit. The bathrobe is provided with a thermostat for regulating the temperature.

The bathrobe is the invention of Mr. Charles Cann, of Salt Lake City, Utah. It also comes in the form of a blanket. Mr. Cann invented the device in an attempt to cure his wife of rheumatism; and he tells us that it was a great success.

Refractory watch-cases yield to this form of persuasion in short order. A vacuum cup affords a good grip



This bathrobe is wired; by connecting the wires with an electric socket you will find yourself greatly invigorated as the electricity warms your blood

She suffers from rheumatism, but expects to be cured soon, for she is wrapped in an electrified blanket; the wires are carefully woven in

A Vacuum Cup to Open Tight Watch-Cases

"SAY, Tom, can you open this watch-case? It's stuck tight." It was a repair man at a watchmaker's who spoke. A screw-back case was stuck and he could not get a grip on it with his hand.

To cope with cases like this a vacuum cup has been invented by Hugh C. Danner, of Martinsburg, W. Va. It is reproduced above.

The cup is made of soft rubber, and has a roughened grip around its upper rim. To open a watch, the rubber opener is pressed against the back of the case. By pressing in the top of the cup a partial vacuum is created, which causes it to adhere strongly. In this way an excellent grip is afforded and the case can then be unscrewed without any further trouble.

Fighting Fire Under Water

Water, water everywhere, but never a drop to put out the fire that threatened the lives of two divers

By Francis Arnold Collins

FEW firemen have ever faced so appalling a danger as did the deep-sea divers who found themselves trapped far below the surface of the water in a burning wreck. The submerged hull in which they worked was filled with compressed air and the abundance of oxygen made the flames spread with abnormal rapidity. Though they were literally buried under water, there was no time to wrench open the hull and let it in. Should they abandon the job?

From the first the work of salving the wreck had proved extremely difficult. The ship had gone down in quiet but deep water, and every effort to raise her with pontoons had failed. It was finally decided to close her hold and some of the superstructure and to blow out the water by compressed air.

The ship had been injured in a lower section of the hull and the work of plugging her hold was less difficult than might be imagined. Like a bottle upside down in the water, it didn't matter so much if there were a small hole or two in the lower side—the water would enter only a little way. But the holes in the top would let out any air forced in and cause the trouble.

Several days had been spent inserting strips of oakum in the openings to stop the leaks and make the upper sides air-tight. Finally the air-pumps were started. Several hours of pumping, however, failed to bring up the sunken ship.

"She leaks," decided old Bill Andrews, veteran at the pumps. "The water's gone out of them upper cabins all right, but when the air gets to pushin' the water on down into the hold, and out the bottom of the ship—why, one of them cabins is leakin' air just enough that the pressure keeps goin' down and the water don't back out only so far. We can't raise the ship unless all the water goes out. Them leaks is got to be fixed."

This statement, though ungrammatical, was entirely correct. Two experienced divers were selected to go down into the air-chamber and investigate. They wore full diving-suits.

The divers reached the hull in safety, made their way through the hole in the bottom and up into the superstructure to the point where the air had driven the water out. Candles were lighted and they started on their tour of inspection. The tiny flame was needed not so much for illumination as to show the presence of a current of air. If a leak had sprung in one of the cracks, then when the candle was held near it the flame would blow the way the air was going—out the leak, and would indicate at a glance the location of the leak.

Clumping laboriously around in their leaden-weighted shoes and heavy suits, the men moved forward, holding the candles to the cracks. Slowly and cautiously they worked, for no one knew better than they that the air-chamber, far below the surface of the water, was ripe for a bad fire. The compressed air had dried out the inflammable materials. An enormous amount of oakum had been used in filling the seams, and the ragged ends of oakum are highly inflammable. Once started, a fire under such conditions would spread with rapidity. Even under ordinary air-pressure the oakum would quickly fan the merest spark into a blaze.

Suddenly a draft of escaping air caught the flame of the candle ahead. Before the diver could draw back, it had leaped to a frayed end of oakum several inches away.

"Fire!"

The worst had happened. There were tons of water above, below, and all around, but no time to wrench open some part of the roof or sides of the cabin and let it in. The flames were spreading with terrifying speed. Without thought of self, the men, driven to the most primitive method of defense, tried to beat out the fire with their heavy mits. Had they forgotten in their excitement another danger that threatened? The smallest hole burned through the air-tight gloves meant certain death—suffocation from the smoke that would pour into the inflated suits, or death by drowning should they attempt to leave the air-chamber. And still they fought, inviting death at every blow.

The dark chamber was lighted only by the fitful flames of the burning oakum. The heavy diving-suits made the work extremely difficult. The movements of hand and foot were slowed down by the weight. A blow that would beat out a flame in an ordinary atmosphere would not suffice here. Desperately they pounded and stamped, working like men in a nightmare who try to escape from peril but are held back by an invisible force. Bit by bit they gained on the swift, fierce flames, which were fed by the light oily oakum and the excess of oxygen in the air. At last pluck won. Under the frantic slapping and stamping the last spark smoldered out.

Suddenly a draft of escaping air caught the flame of the foremost candle, and before the diver could draw back, it had leaped to a frayed end of oakum several inches away

Clad in heavy, clumsy diving-suits, the men were sent down to search for the air leak in the sunken hull

Then only did the divers think of retreat. Their gloves, though badly singed, were fortunately intact. Slowly they retraced their steps through the dark winding passages, until they reached the free water. With a jerk, they signaled to be drawn up.

As they crawled over the rail of the ship above, a strong smell of burnt rubber still lingered about them. Once safe above the ground, or rather the water, they sat down for a quiet smoke. Old Bill Andrews labored up a hatchway.

"Hello, what's up?" says he, hunting for his favorite oilcan.

"We are," was the laconic reply, "and if you don't mind we'll stay up."

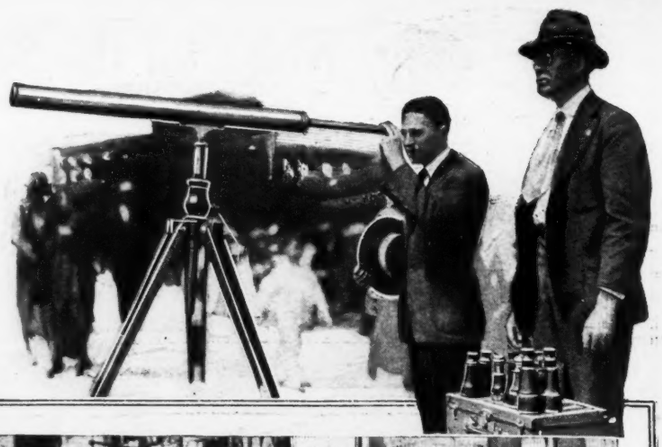
They Faced Death by Fire at the Bottom of the Sea

The hull of the sunken ship was filled with compressed air, and the abundance of oxygen made the flames spread with appalling rapidity. Though they were entirely surrounded by water, there was no time to break through the roof or sides of the cabin. But the men would not desert their job. Weighed down by their clumsy diving-suits, which made every slightest movement an effort, they fought back the flames with their hands. One small hole burned through their inflated rubber suits meant death by either suffocation or drowning

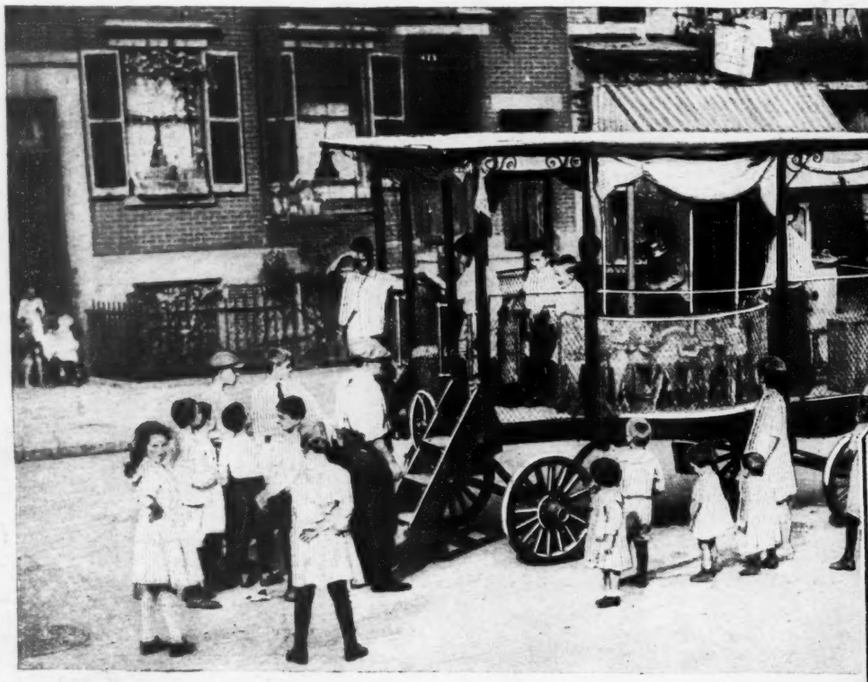
How to Earn a Living

If you don't like your job, why not try one of these?

Photographs © Press Illustrating Service



This man has mounted a telescope in Battery Park, New York, and he charges five cents a look. By day the people look at the sun and by night at the moon



From street to street he travels with his merry-go-round, charging one or two cents a ride; the children ride the small horses that go round and round while a tin-panny piano plays a tune

He whistles for a living; yes, he really does. And when you hear the birdlike tune you promptly buy one of his whistles. He stands on a crowded corner and works industriously all the day long

Collar buttons are this man's specialty; he stands on the corner buttoning and unbuttoning his collar while a crowd gathers round and watches him. He demonstrates the superiority of his particular collar button, and sells many like it

"Umbrellas to mend!" This man shouts through the streets while he carries on his back the mending-machine. His customers are many, for umbrellas, like everything else, have gone up, and it's much cheaper to have your old one mended than to buy a new one

Noise for the Silent Drama

Parrots shriek, lions roar, airplane motors hum—all from the orchestra pit

Photographs © International Film Service

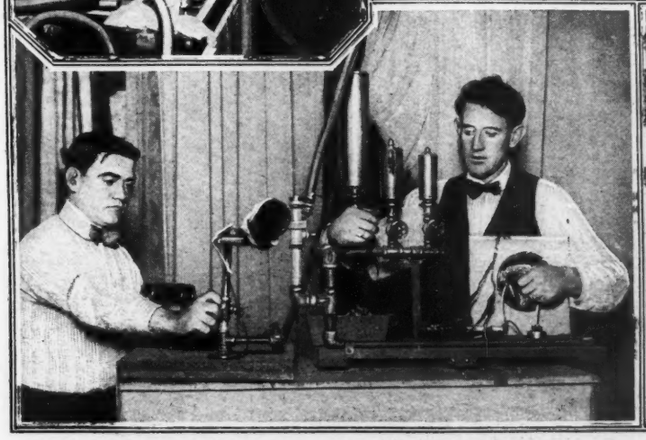
He's got his hands full of instruments for imitating birds. When Mary's pet gets a close-up, be it a parrot or a canary, Mr. Manne reaches over, picks up an instrument, and soon the theater is filled with the singing or chattering of birds, as the case may be

Poor Nell, the outcast, sank to the ground exhausted; the rain poured down, the lightning flashed, and the thunder growled ominously. And this is what happened behind the screen: one man made the thunder, another flashed the lightning, and a third imitated the rain

They look like frying-pans and saucepan lids, but they are only some of the gongs that hang on the wall; Mr. Manne sits with his back to them and simply reaches up when Chi Chu, the Chinese dope dealer on the screen above, pounds for his servants

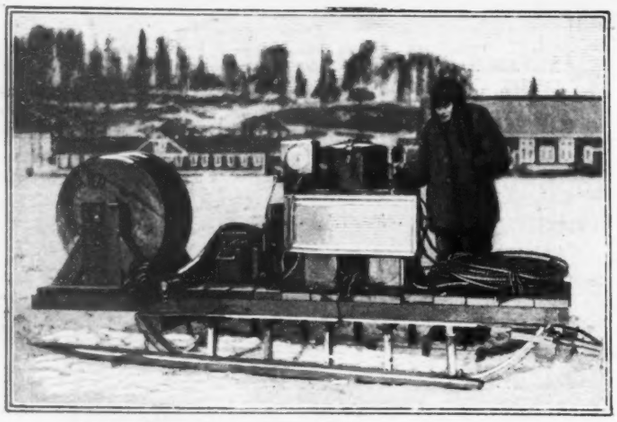
And the villain still pursues her—on horseback; whereupon Mr. Manne gets out his two imitation hoofs and plays a tune with them on a board, keeping time with the horse on the screen

The musical director can order the "Anvil Chorus" any time he wants to; Mr. Manne keeps a hammer and a good sized anvil down in the pit with him all the time



Train whistles and automobile horns are not easy to imitate; an electric circuit is involved and two men are usually needed to run it; the man to the left is getting ready to let off a shrill one

You might think this a hardware store; in reality it is the drummer's end of the orchestra pit of one of New York's largest moving-picture houses; Mr. Max H. Manne, the man in the case, performs on over three hundred instruments



This is an electrical machine used for thawing the ground in Alaska, where a railroad was to be built

Thawing Ground by Electricity

AN electrician connected with the Alaskan Engineering Commission has fitted up a thawing-machine that can be used to prepare the ground for pile-driving or excavating wherever electric power is obtainable.

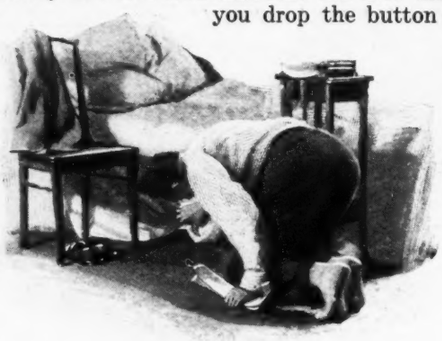
A steel pipe, equipped on its interior with a resistance coil, is fitted at one end with a sharpened steel point and at the opposite end with a solid steel driving-head. There is an insulated electrical connection with the enclosed resistance coil. The pipe is driven into the frozen earth to the desired distance and connection is made with the power transmission line through a portable transformer station mounted on a sledge, as shown in the illustration.

The voltage of the current is reduced and the amperage greatly increased. The resulting heat generated in the resistance coil is communicated to the enclosing steel of the pipe, and radiating therefrom thaws the surrounding earth. The water from the thawing ground cannot reach the resistance coil and hence its temperature is not reduced. In a comparatively short time the ground is sufficiently thawed to permit the withdrawal of the driven pipe and the introduction of a wooden pile, which is readily driven to the desired depth.

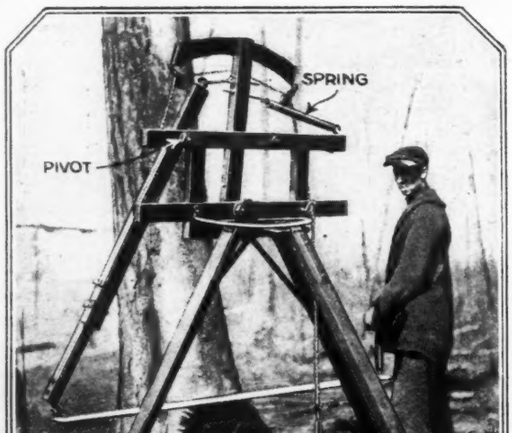
Where's the Collar Button?

DOWN on his knees, the man in the picture below looks under the chairs, under the table, under the bed. Is he hunting for a burglar? No, oh no! He is only looking for a collar button that slipped out of his fingers and rolled away. In his haste to find it he took his clean collar with him and is wiping the floor with it.

Such disasters are not necessary if you use the collar button recently invented by Frank Cadden of Chicago. It comes in shape no bigger than an ordinary collar button, but it is heeled with rubber and has a decided center of gravity due to a lead disk that fits into the base. Should you drop the button the lead weight would insure its landing right side up and the rubber base would keep it from skidding. Thus you would find it at your feet.



He's looking under the bed for his collar button; if he had used one of the new weighted buttons it would have fallen at his feet and stopped there



One man can work this saw; he pulls on his end and a spring jerks the saw back

Lighting Up the Tight-Rope Walker

THE tight-rope walker flashes on and off as if he were a lighthouse. At each step the buttons on his breeches flash on and off—they are colored electric light bulbs.

His shoes have metal toes and heels that close an electric circuit every time the walker has both feet on the rope at once. Wires run up his legs to the buttons and his feet are enclosed in non-conducting shoes.

The tight-rope is wired in sections so that alternate sections are a continuation of each other.

The wire that carries the current is wound around the rope and is so arranged that there are many contact points.

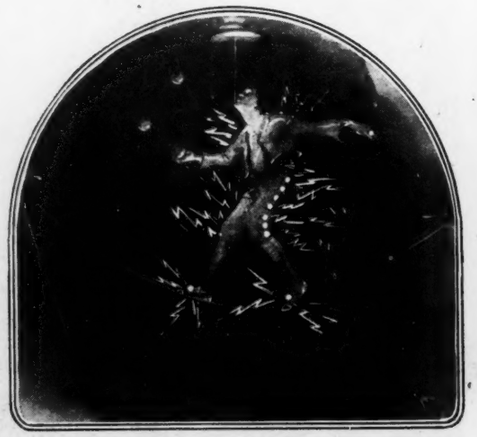
The Spring Is the Other Man on This Saw

IF you will look toward the bottom of the photograph above you will see a saw attached to the end of that bar on the left. The center of the saw is embedded in the trunk of the tree and the opposite end rests in the hand of the workman.

He is sawing down the tree by himself—or, rather, with the aid of a spring. As he pulls on the saw the anchor-shaped device on the top of the stand is swung unwillingly to the left—the spring tries to hold it back. As the man finishes a stroke he releases the handle of the saw and the spring promptly contracts, making the cut in the opposite direction.

This saw was invented by Charles A. Moore, of Kinney, Minn. It happened this way. He was a boy at the time of the Civil War, living in Virginia, and when the men left to go to war he had to hold down a man-sized job in the fields, and take a turn at the wood-pile "with an old wabbly bucksaw and a dull ax."

Many years later he drifted back to his old boyhood home, and there, to his great surprise, he found the same old ax and saw in operation. Astonished at the lack of progress, he built the saw shown above.



The electric light buttons on his breeches flash on and off, for metal heel and toe contacts are continually opening and closing a circuit

© International Film Service

Raising bees in order to conserve the sugar in flowers that is ordinarily wasted

Rope Shoes Made by a Sailor

THE Peabody Museum at Salem, Mass., harbors a pair of rope shoes. They were worn many years ago by a sailor on a whaling vessel. He used them to keep him from slipping on the greasy decks. The shoes, which are now badly discolored, were originally made of manila rope.

They are shaped very much like the regulation Indian moccasin and look as though they were easy to make. They might still be useful on the modern steam whaler, for whale oil has lost none of its ability to make the deck of a vessel a very good substitute for a skating-rink.

© International Film Service.

A red light on his head and white lights on his shoulders guide the traffic

Better Keep Bees

SUGAR is increasingly scarce and expensive; yet right around us there is an almost unlimited source of it going to waste—the flowers. The bee will gladly gather it for you if you provide it with a hive.

Students at Harvard College have built themselves simple hives like the one shown above and have got as much as thirty pounds of honey from a hive in the rush season.

Of course, some honey should be left for the bees.

These rope shoes were worn long ago by a sailor on a whaling vessel to prevent slipping on the oily deck

A Lit-Up Policeman

WHAT'S that red light ahead? You wonder. It's in the right place for a traffic post, but it moves! As you reach the corner you see that the light is on a policeman.

A lit-up policeman is shown above; he has a red light on his head and two white lights on his shoulders. He wears a pair of long white gloves on his hands, two white straps across his chest, and carries two batteries in his overcoat pocket.

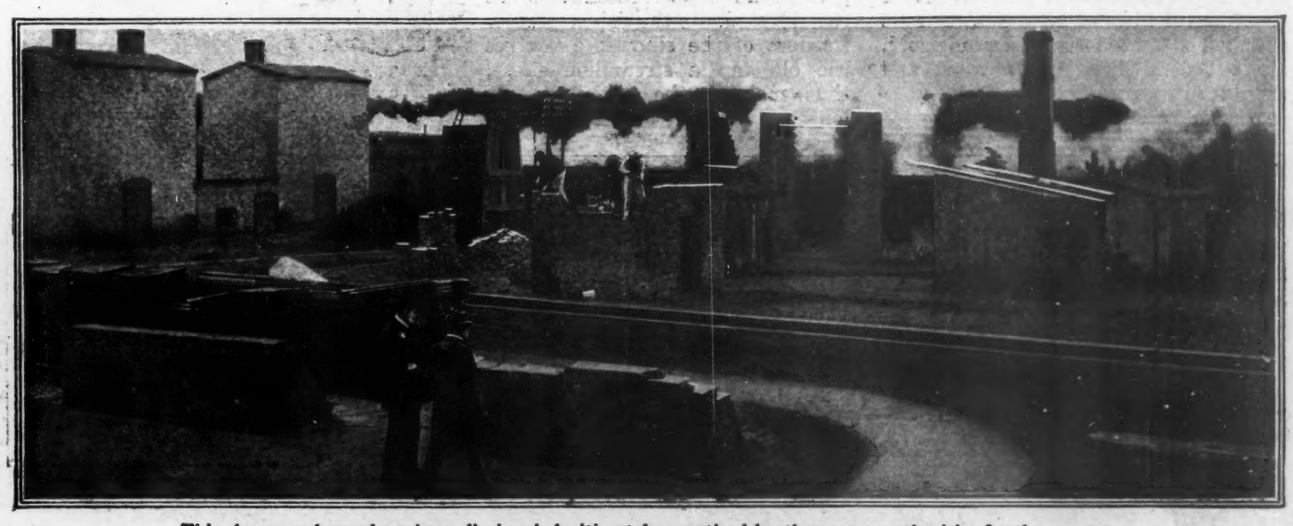
This particular policeman regulates traffic at a corner in Boston.

Testing Building Materials by Fire

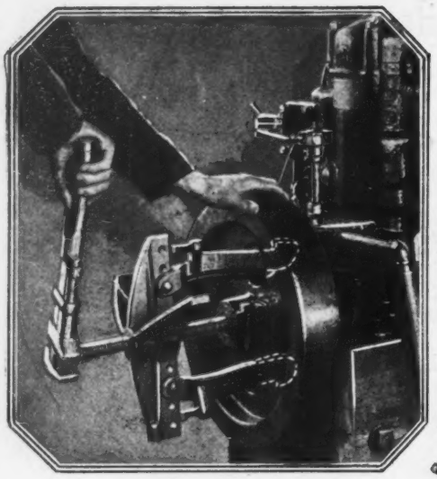
IF you wish to ascertain whether a building is fireproof, set it on fire. This method is thoroughly reliable but unsatisfactory for obvious reasons.

The modern method is illustrated by the accompanying picture. In a large open space small buildings are erected from the material to be tested or incorporating such material under conditions similar to those surrounding them in actual practice. Then they are set on fire and allowed to burn for a certain period. The behavior of the material during the fire is carefully observed and its resulting condition noted.

Iron, steel, stone, brick, cement, and other building materials are thus tested. By the same method the effectiveness of fireproofing materials is practically demonstrated and information collected as to the effects of extreme heat on the supporting power of iron, steel, concrete, or stone columns, beams, trusses, and other structural units.



This shows a place where incendiarism is legitimately practised by the proper authorities for the purpose of testing the resistance which iron, steel, stone, brick, cement, and other building materials have to fire



The puller with its spiderlike framework grasps the flywheel and forces it from the shaft by means of set-screws which are tightened

To Remove Flywheels

THE simple puller shown above was devised to remove an automobile or motor-boat engine flywheel.

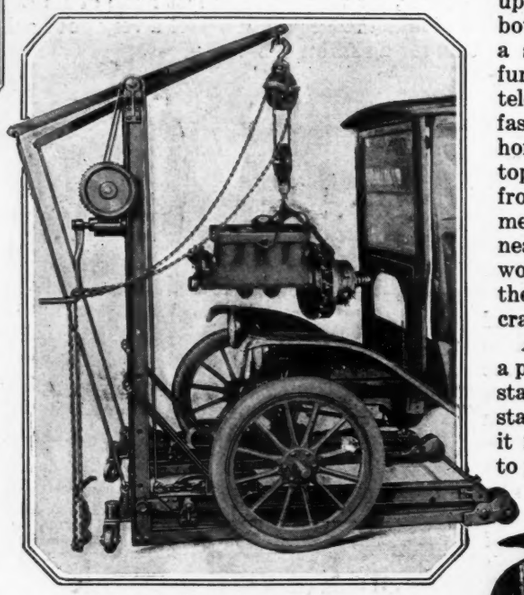
The hooked rods are pivoted to the spider arms and their other ends made to grasp the flywheel in the most convenient location; the set-screws on the rods are then tightened up against the spider arms; the center bolt is screwed down through its boss until it touches the end of the flywheel shaft and the bolt is then turned with a monkey-wrench until the flywheel is forced off.

Making Repairs Without Getting Under

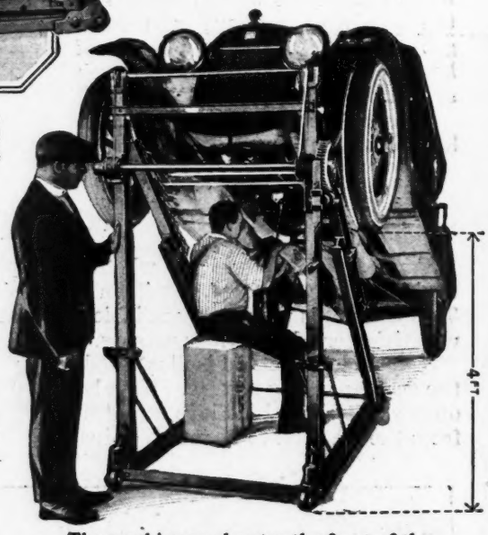
A MAN in Chicago made a study of the conditions met with in the maintenance of the six and one half million automobiles and motor-trucks in the United States, and found that fifty per cent of the repair work is done from underneath the chassis. He immediately devised a hoist to lift either end of a car or truck three or four feet off the floor so that the repairman can work on the parts underneath without lying on his back. Furthermore, with this machine an engine may be overhauled without taking it from the car; for by removing the lower half of the crank-case and lifting the front end of the car, the main and connecting rod bearings can be examined just as easily as if the motor were removed and placed on an engine stand.

The machine consists of two metal uprights and two horizontal arms, both suitably cross-braced to form a self-supporting stand, which is further braced by two additional telescoping or oversliding arms fastened to the far ends of the two horizontal members and to the tops of the vertical bars. The front end of the vehicle is lifted by means of cables attached underneath the axle, the cables being wound up on drums hung from the vertical bars and operated by crank handles.

A crane-boom attachment forms a part of the outfit and may be installed in a few minutes' time. The stand is mounted on roliers so that it may easily be moved from job to job as desired.



With the addition of the boom arm it can be used as a crane for lifting all sorts of things in a repair shop



The machine so elevates the front of the car that the mechanic may easily work under it without having to lie down

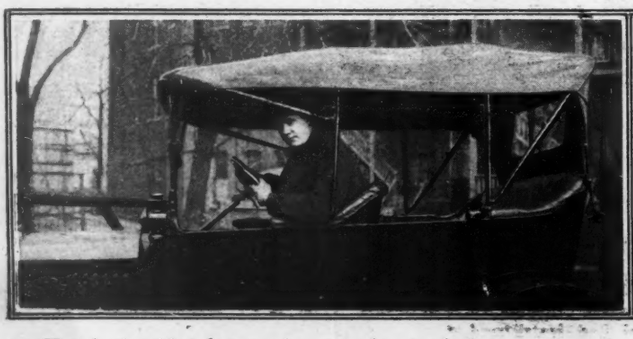
The One-Man Ford Top Is Here

NOW comes a converter to change the old-fashioned Ford top into a one-man design. The old top and all of its fixtures are retained except the unsightly front bow sockets, which are discarded.

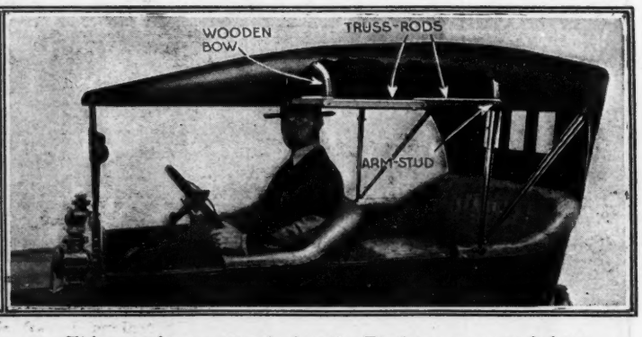
The converter connections, which consist of two side truss rods extending from the rear bows to the front of the windshield, and two vertical rods clamped to the sides of the windshield, are out of sight when installed and should outlast the car itself.

A good point about this converter equipment is that it costs less than ten dollars and may be installed in about an hour's time without the use of any special tools.

It has a number of improvements over the old top; it can be manipulated by one person; makes it easier to enter or leave the car; permits an unobstructed view at the sides; allows the driver greater freedom of the elbows; and gives the old top a streamline effect, thus making the body appear longer.



Here is the old style top, where one has to duck to avoid the cross-piece when admiring the scenery or getting out of the car; certainly a rather awkward arrangement



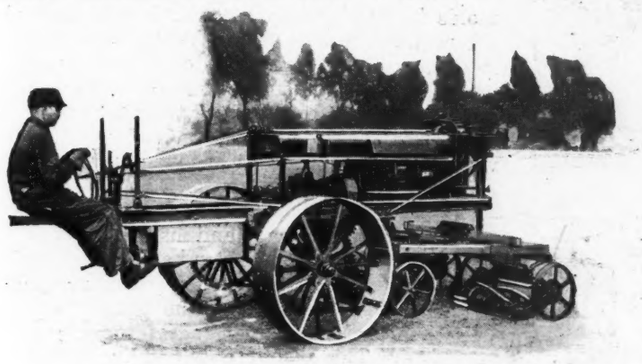
This contrivance attached to the Ford top converts it into a one-man design which can be raised or lowered at will. How clean-cut this is compared with the car at the left

At Home Even on the Links

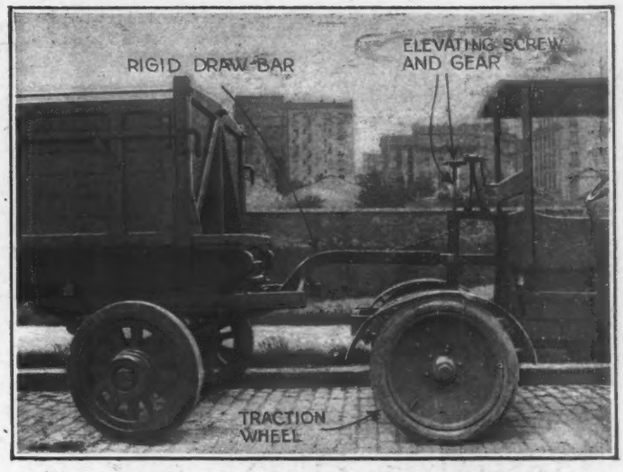
NO more will Colonel Bogey be hindered and tripped up by the imprints of horses' hoofs on the golf links, nor will his long drives be found nestling snugly in the little hollow where stepped some heavy-weight horse while pulling the mower.

It is now the fashion for golf clubs to mow their links with motor cultivators. The cultivator shown in the illustration was built for regular farm work, but when they hitched the mower to the cultivator, and started across the course, it was seen at once that they had hit upon a method of mowing that far surpassed the horse mower, both in the saving of time and the quality of the job.

The cultivator requires only a few slight changes in the attachments to prepare it for raking the golf course and doing various odd jobs in parks or gardens.



This new champion of the golf links plays the course in half the usual time consumed by horse-drawn apparatus



The greater the trailer load, the greater the downward pressure applied to the tractor's rear wheels by this connection

New Tractor-Trailer Connection

A NEW type of connection between a motor tractor and a four-wheeled trailer is designed to vary the pressure on the rear tractor wheels so that, no matter what the load carried in the trailer, the tractor rear wheels will always have sufficient traction to start the load.

A varying proportion of the weight of the load is exerted on the tractor platform by attaching the front end of the rigid trailer drawbar to an eye on the rear deck or platform of the tractor. This eye may be raised or lowered by a worm-and-screw device operated from the driver's seat. Thus a greater or less pressure may be exerted.

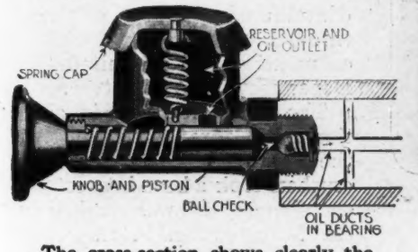
Getting Rid of Grease on the Automobile

SLOWLY but surely the automobile engineers are getting rid of grease-cups and replacing them with oil lubricators. Grease-cups have never been entirely satisfactory because the caps rattle off under vibration, as when the car is going over a rough road, and because grease does not lubricate when it hardens. Oil, on the other hand, lubricates more readily because of its greater fluidity. Until now, the problem has been how to build an oil-cup that would not rattle off or permit the oil to leak out while the car was standing still.

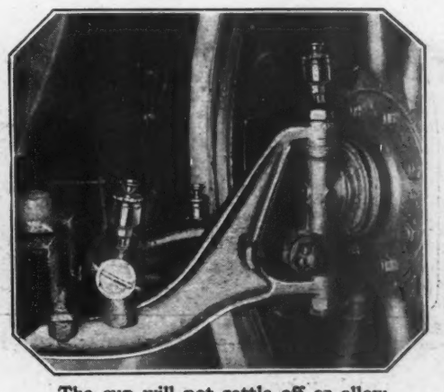
The latest type of oil-cup is made in two forms, one with a vertical barrel for such parts as the steering knuckle and drag-link, and the other with a horizontally placed barrel for such parts as the front and rear spring bolts and shackle bolts. The vertical barrel type is thus used at four places on a car, two alike on either side, and the horizontal type at twelve places, six alike on each side of the car.

Both types are designed on the same principle and include an oil reservoir emptying into a small cylinder. This cylinder is fitted with a piston which normally is kept at the bottom by means of a spring around the piston-rod, which extends out through the top of the oil reservoir in the case of the vertical type of cup and out of one end of the cylinder in the horizontal type. At the bottom of the cylinder in each case, on that end nearest the bearing to be lubricated, is a ball check valve like that shown below in cross-section.

A knob is provided on the end of the piston-rod, outside of the cylinder.



The cross-section shows clearly the extreme simplicity of the oil-cup



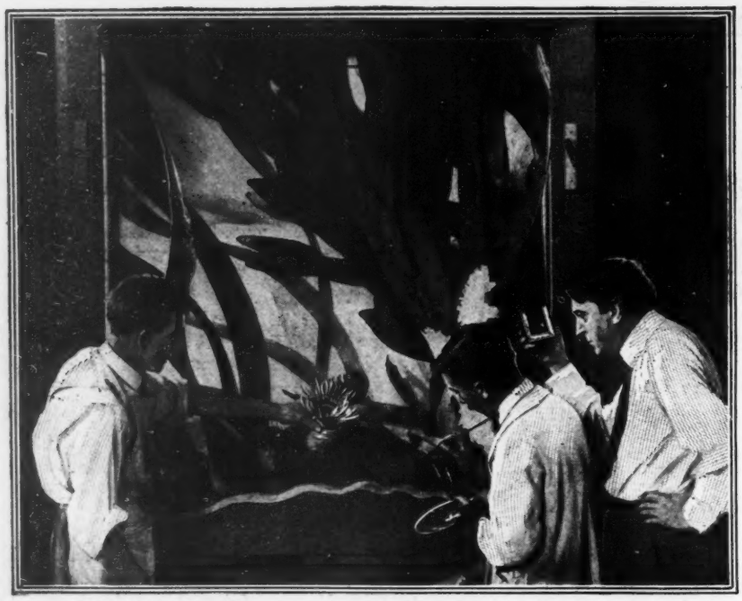
The cup will not rattle off or allow the oil to leak while car is standing

A pull on the knob of each oil-cup oils the car

When this knob is pulled, it moves the piston to the top of its cylinder, uncovering a hole leading from the oil reservoir and permitting the oil to fill the cylinder. Then, as the knob is released, the piston moves back by reason of the coil spring around the piston-rod, pushes the ball check valve off its seat, and forces the oil into the bearing.

With a car equipped with these oil-cups, it is necessary simply to walk around it and pull out each oil-cup knob once or twice and let it snap back in place. Each cup holds enough oil for from two weeks to a month, depending upon the use of the car.

By keeping the oil in a separate compartment, it is only fed to the bearing each time the knob is pulled out and snapped back.



The seaweed is made of wax, the shell-fish of wax with glass tentacles, and the section of scallop shell on which it rests, of plaster of Paris. The whole is a realistic picture of life at the bottom of the sea

To make glass work as fine as lace, all you need is a blowpipe and a pair of skilful—very skilful—hands

Reproducing Nature in Wax and Glass and Plaster

WHEN the American Museum of Natural History, in New York, decides to make a wax model of what the movies would call a "close-up" of the bottom of the sea, Mr. Roy W. Miner, the Associate Curator of Invertebrates, assembles his staff of three experts and takes them to the place where the weeds and sea-creatures that he wishes to reproduce are to be seen in real life. Photographs are taken; Mr. Shimotori, the artist, makes drawings in color; and Mr. Chris E. Olsen makes a small clay model to scale right on the spot.

From his models Mr. Olsen makes plaster molds in which white beeswax is cast to make the required leaf or fish. When the modeling is finished Mr. Shimotori colors the various parts. He uses oil colors and applies them with ordinary artists' brushes and the air-brush. In the lower picture Mr. H. Mueller, with the working drawing in front of him, is making delicate glass spines for a wax sea-worm's head. His apparatus consists merely of a gas blowpipe and his skilful hands.

The under-water background has to give the impression of fading away into the distance, and the light has to be carefully adjusted accordingly.

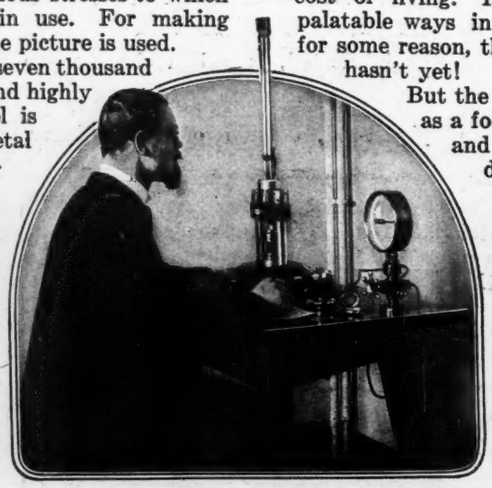
This effect is obtained by making the background of five separate sheets of glass, one in front of another. Upon the first are painted seaweed and fish, slightly blurred at the edges. On the other sheets of glass are painted objects of greater and greater indefiniteness. Finally, the ground-glass window behind the model is colored the greenish tint that water gives, and behind it a series of prisms is arranged to diffuse the light.

A New Way to Test Metals

IRON, steel, and other metals employed for technical purposes are now carefully tested for their surface hardness and their power of resisting various stresses to which they may become subjected while in use. For making these tests the apparatus shown in the picture is used.

By a hydraulic pressure as high as seven thousand pounds to the square inch a small and highly polished ball of extremely hard steel is pressed against the surface of the metal to be tested. The depth of the impression made in the surface of the metal is measured by delicate instruments and the relative hardness of the metal is determined by comparison with a predetermined scale.

The same apparatus and the same method, called the Brinell test after its inventor, is also employed for stress tests of metals. After the steel ball has been pressed in the surface a cross-section of the tested metal is made which is etched with acid and then examined with the microscope which discloses all structural changes produced in the metal by the pressure of the ball.



In testing the surface hardness of metals a hard steel ball is forced against the metal by hydraulic pressure. This man is watching the manometer indicating the pressure applied in the test

Soya Beans to the Rescue

THE praises of the Chinese soya bean as food have been sung by experts who wanted to bring down the cost of living. Industriously they gave exhibits of palatable ways in which it could be prepared. Still, for some reason, the soya bean as food didn't take—or hasn't yet!

But the soya is a versatile bean. Cast off as a food, it proves itself valuable as a paint and varnish oil! Its possibilities in this direction were first investigated some time ago, when the failure of the flax crop in the Northwest caused a serious shortage of linseed oil. A large quantity of soya beans was imported from Manchuria and distributed pretty generally through the country with the cooperation of the United States Department of Agriculture.

The beans grew well in all sections, but throve most lustily in the South. Here the cottonseed crushers took a keen interest in the experiment. Oil was crushed from the beans grown in this section and experiment established its desirability as a paint oil.

The Diamond and Its Bloody Story

All the revel, riot, recklessness, quick dramas, and dazzling riches of all the world's mining rushes and gold stampedes are crowded into the mad romance of the diamond

By Walter Noble Burns

ALL the diamonds in the world could be packed in your wife's clothes closet. They could be stored in a kitchen pantry, where, in the dim light, the cook might mistake them for navy beans and attempt a puree. They would form a pile about as big as the pile of coal the truckman dumps on the sidewalk at the basement entrance to your apartment building. If the pile had a base diameter of eight feet and were rounded into a cone, it would be five feet high. A pile of coal of equal size—and coal by every tie of chemical relationship is the diamond's first cousin—would cost $28. The pile of diamonds, reckoned at $100 a carat, would have a value of $4,635,547,480. If figured at current diamond prices, it would be worth from three to five times that much.

There are, it is estimated, 46,355,474 carats of cut and polished diamonds in existence. In terms of avoirdupois they would weigh 10½ tons. The total includes possibly the first diamond ever found on earth—who knows?—and the last gem picked from the chimneys of South Africa; the little twinkler that the shop girl wears on her finger and the Kuh-i-Nur that blazes in Great Britain's crown.

The War Advanced Diamond Prices

One hundred dollars a carat, used as a basis in the estimate, is perhaps below the average cost of diamonds throughout history. Diamond prices have been subject to wide variations. The war advanced the price about one third. Present prices are about one hundred per cent. higher than those of fifty years ago, and they undoubtedly will go higher in the next few years. But every diamond is an individual problem as far as price is concerned. The price always depends on the stone's color, comparative flawlessness, inherent brilliancy, and cutting.

A one-eighth carat diamond sells at present for from $12.50 to $20; one-fourth carat from $37.50 to $62.50; one-half carat from $100 to $200; three-fourths carat from $187.50 to $337.50; one carat from $300 to $500. Importers buy rough diamonds in foreign markets for about $90 a carat. A rough crystal of 2½ carats, which will cut to a gem of one carat, costs $225. Import duty is 10 per cent.; 1 per cent. is to be added for insurance and brokerage charges; the labor of cutting may be figured at $15. The polished one-carat gem thus represents an outlay of about $250. If this diamond turns out to be a gem of first quality, it will retail at from $500 to $550.

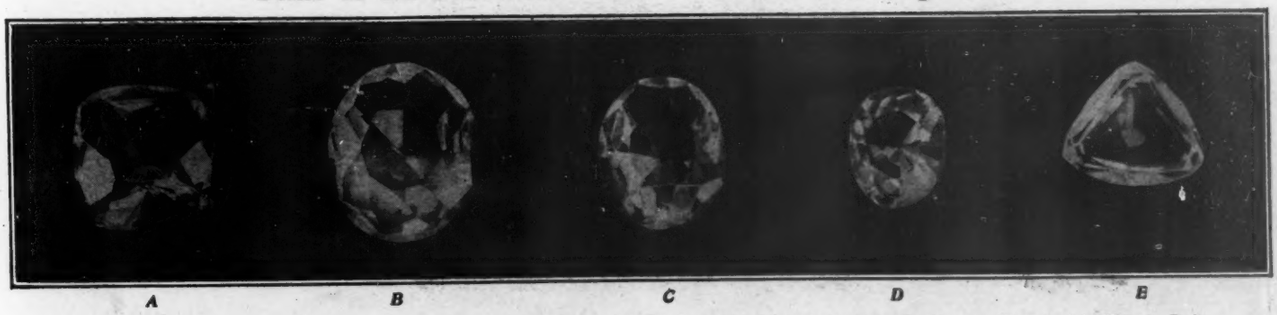
But such quotations are not wholly dependable. Some blue-white one-carat stones sell for $2,500, while you can buy a one-carat yellow diamond for $150. Blue-white diamonds bring the highest price in the market. But many connoisseurs prefer as more beautiful the snow-white gem often found among river diamonds, whose sharp, cold brilliancy is like that of clear ice gleaming in winter sunshine.

The diamond was a clumsy jewel of dull luster until the art of cutting and polishing it was discovered in the fifteenth century. If the stone is large the first step is to make an incision and then to cleave it with a mallet, which two steps are illustrated by this picture

Democratic Uncle Sam and His Diamonds

The United States in recent years has become the greatest diamond-buying nation on the globe. For years it absorbed from fifty to sixty per cent., and during the war 85 per cent. of the output of the South African mines, which supply 98 per cent. of all the diamonds in the world's markets. A recent estimate placed the value of the diamonds in this country today at $1,350,000,000. Of this $500,000,000 was set as the value of the stones in the country in 1900. Importations since 1900 have amounted to $506,000,000, this including

Some of the Diamonds that Have Had a Thrilling Past



A B C D E

The Regent, or Pitt (*A*), weighed 410 carats, and was bought for about $120,000 by Pitt, Governor of Madras. The Duke of Orleans, Regent of France, peid $400,000 for it. It was cut to nearly 137 carats, and was stolen during the Revolution, but was recovered and is still in France. The Kuh-i-Nur (*B*) led one Indian potentate to kill his three brothers and imprison his father. It has been cut and recut. It weighs now 125 carats and has been valued rather fancifully at $1,000,000. The Pigott (*C*) weighed 82 carats. It was last heard of in Egypt. It is valued at $150,000, rather little for a stone of such size. The Empress Eugénie (*D*) weighs 51 carats, and is the property of the famous Gaikwar of Baroda. Two centuries before it shone on the bosom of the proud Eugénie it was given by a peasant to a blacksmith for mending a plow. The Duke of Westminster owns the Kassak (*E*), weighing something under 79 carats. Little is known about it

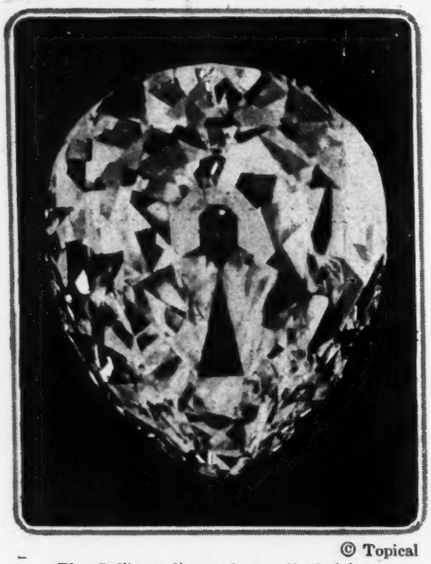
$175,000,000 worth of rough stones which were doubled in value by cutting.

Prosperity has no better barometer than the diamond trade, and the increase in diamond buying year by year has reflected the nation's growing wealth. Yearly importations of cut diamonds increased from $1,317,420 in 1867 to $27,000,000 in 1913. They fell to $18,000,000 the first year of the war, and to $9,000,000 in 1915. They showed a reaction from war conditions in 1916, when they reached $20,567,222, and were $21,855,735 in 1917 and $13,925,772 in the first eight months of 1918. The diamond-cutting industry in the United States began in 1873, when $176,426 worth of rough stones were imported. Importations amounted to more than half the importations of cut stones in 1916 and 1917, and had become almost equal in 1918.

Time was when they adorned only the princes of the earth and sparkled only in palaces. But they have become a democratic gem in the great democracy of the West. The stenographer emits Kimberley sparkles. Faint Dutoitspan gleams show in the ears of the pretty waitress. No cook or housemaid can hold up her head without a diamond among her jewels.

Diamond Cutting—a Distinctly Modern Art

The perfectly cut and brilliant diamond the world knows today is not more than fifty years old. The ancient world knew little of diamonds. From the first pharaoh to the last, through all the pageantry of thirty-one dynasties, diamonds were unknown in Egypt. From the dawn of history, Babylon remained unfamiliar with them for forty centuries. The pioneering conquest of Alexander across the Indus in 327 B.C. acquainted Greece vaguely with their existence. The patricians of Rome in the days of the early empire rarely owned them. Byzantine supremacy, the rise of Venice to maritime power, the Moorish conquest of Spain, brought only a trickle of diamonds into western Europe. A fashionable jewelry store in America today carries more diamonds in stock than were in all Europe when Columbus sailed from Palos.



© Topical

The Cullinan diamond was divided into nine large stones and a number of small brilliants. Here is the biggest of the stones. It weighs 516½ carats and is the largest brilliant in the world

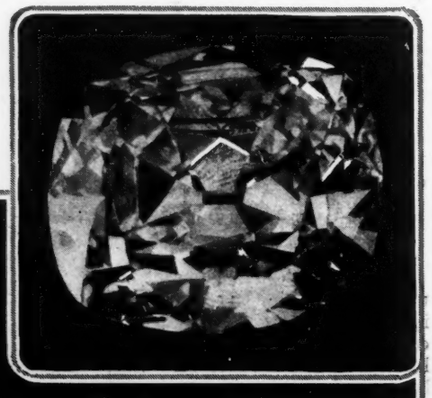
To the right is a brilliant weighing more than 309 carats. It is the second largest stone cut from the famous Cullinan

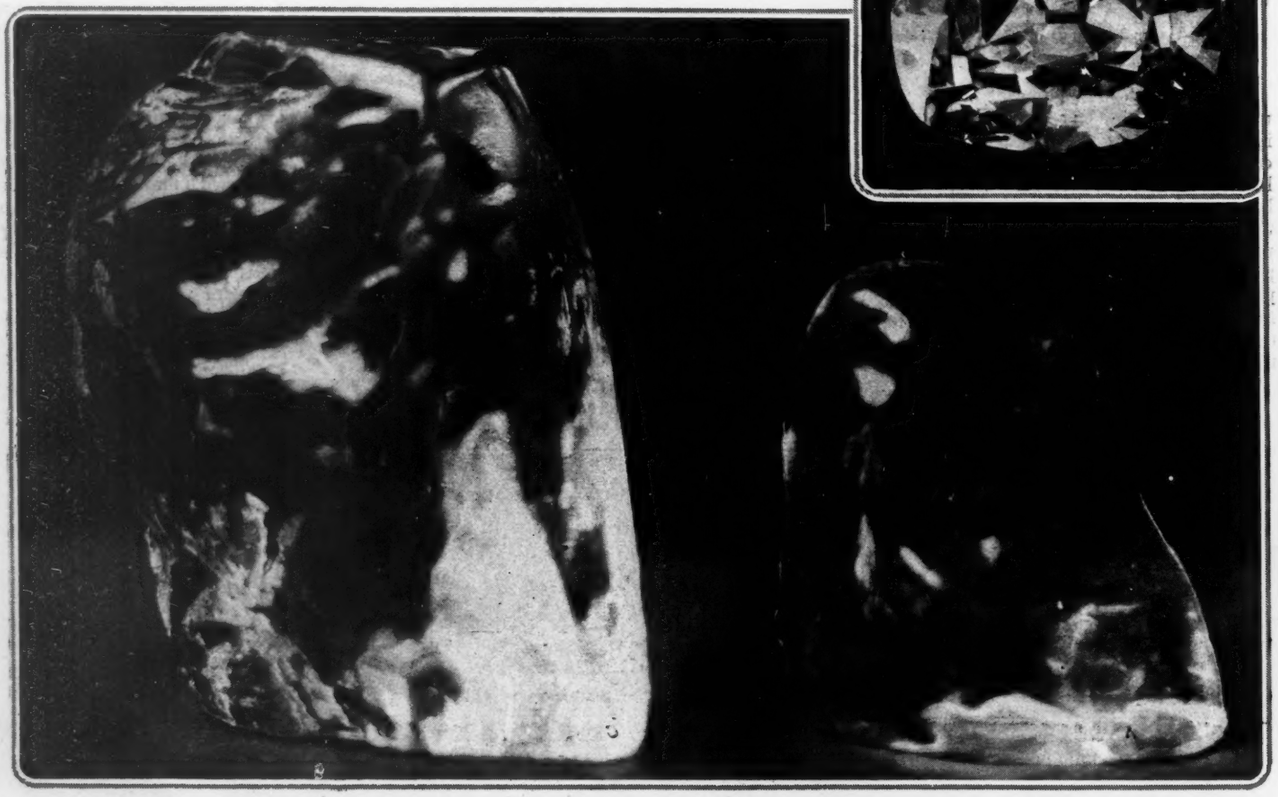
The earliest cutters used their wheels deftly enough, but they neglected their mathematics. Bringing out a diamond's full brilliancy is a mathematical problem. Increase of facets adds to surface area and surface glitter. But the angle of total reflection must be considered in relation to the angle of incidence, and the facets so arranged that a ray of entering light will be reflected from the inner facet surfaces and returned in refracted rainbow sparkles through the top of the stone.

Making the Diamond Sparkle—a Mathematical Problem

Henry D. Morse, of Boston, in the last century was the first to discover the balanced proportions that developed a diamond's highest reflective and refractive possibilities. Since brilliancy is the crowning glory of a diamond, he did not hesitate to sacrifice whatever weight was necessary to achieve it. Retaining the fifty-eight facets of the earlier cutters, he found that a diamond is at its sharpest climax of brilliancy when its depth from table to culet is six tenths of its diameter, and a little more than two thirds below. Cut in this style, a diamond not only flashes light from every polished facet surface, but seems alive with coruscating inner fires.

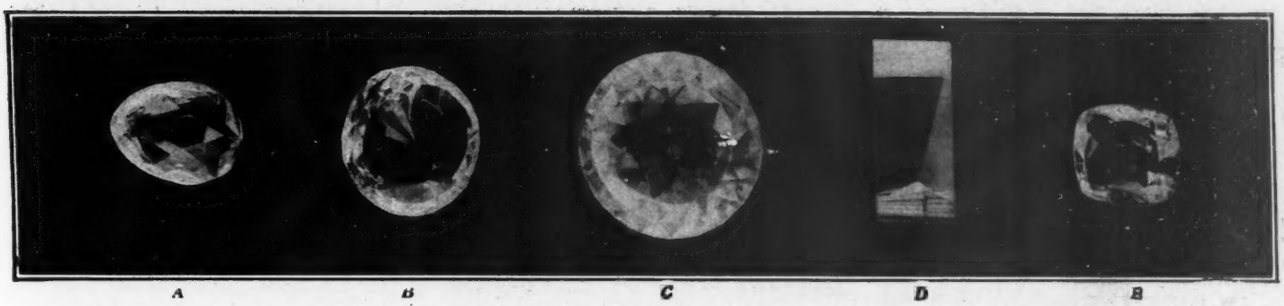
Morse's proportions are the rule of the world today, and they mark the final





To the left is the Cullinan diamond as it appeared in the rough. It weighed in this state 3,025¾ carats (1½ pounds) and was as white as water. The stone was purchased from the Transvaal Government in 1907 and presented to King Edward VII

To the right is the Excelsior diamond, found in 1893 at the Jagersfontein by a native while loading a truck. It weighed 971 carats in this rough state, and was ultimately cut into ten stones weighing from 68 to 13 carats



A B C D E

Swallowed by a faithful serving-man to save it from the robber who slew him, the Sancy (*A*) was sliced from his stomach to adorn the royal person of Henry of France and Navarre. The Orloff (*B*) was stolen by a French soldier from the eye of an idol in a Brahmin temple, stolen again from him by a ship's captain, bought by Prince Orloff for $450,000, and given to the Empress Catherine II. It weighs nearly 105 carats, and was one of the Russian crown jewels. The great Mogul (*C*), most magnificent of Indian gems, disappeared from history, never definitely to reappear. It has a bloody history going back to the year 1665. Its fame lured Nadir Shah to the sack of Delhi. This is a glass reproduction made from extant descriptions. It probably weighed after cutting, 280 carats. The Akbar Shah (*D*) was originally a stone of 116 carats with Arabic inscriptions upon it. After being cut down to 71 carats it was bought by the Gaikwar of Baroda for $150,000. The Polar Star (*E*), a magnificent stone weighing 40 carats, belongs to the Princess Youssoupoff

triumph of art in the achievement of the perfect modern jewel.

Fiction in its maddest moods never invented romance more bewildering than the stories of the great diamonds of India. For these baubles wars have been waged, nations devastated, thrones and dynasties overturned, men slaughtered by tens of thousands. For gems men have plotted, intrigued, robbed, murdered, committed every cruelty and treachery, stained their souls with every crime.

The fame of the Great Mogul lured Nadir Shah to the sack of Delhi. Desire to possess the Kuh-i-Nur was woven into the complex motives that led Aurung-zeb to deluge India with blood, slay his three brothers, and dethrone and imprison Shah Jehan, his father.

The Orloff, stolen from the eye of a temple idol and sold overseas, was presented to Catherine of Russia by her princely paramour to patch a lovers' quarrel. Swallowed by a faithful serving man to save it from robbers who slew him, the Sancy was sliced from his stomach to adorn the royal person of Henry of France and Navarre.

The Great Mogul, the most magnificent gem of the Indian mines, disappeared from history, never definitely to reappear, its fate a riddle of the centuries.

© Harris & Ewing

The ill-starred Hope diamond eventually passed into the possession of Mrs. Edward Beale McLean, whose husband bought it for $300,000. She wore it on one occasion together with the Star of Este, the two stones together being worth $500,000. The occasion was a dinner which, a curious statistician figured, cost about $166 a minute

The Baleful Gleam of the Hope Diamond

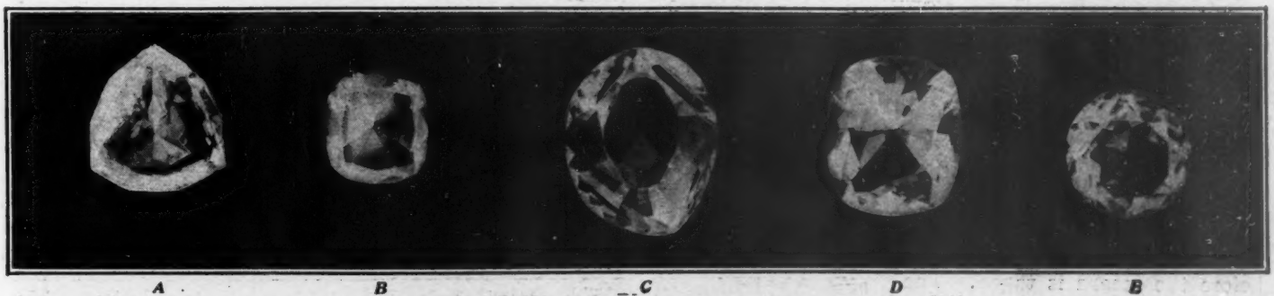
The Hope blue diamond—stone of tragic fame—is the only one of the great historic diamonds to come to the United States. When Louis XIV bought it in the seventeenth century, it was a gem of 67½ carats. It disappeared during the French Revolution, and remained lost until 1830, when it reappeared as a jewel of 44¼ carats.

From its first appearance in Europe, a superstition has clung to it that it brought disaster to all whoever owned or wore it. Certainly it has been associated with a long list of tragedies. Tavernier, who brought it from India, failed in business, and died on his voyage back to the Orient to recoup his fortune. Madame de Montespan, upon whom the Grand Monarque bestowed it, was supplanted in the king's affections by her rival, Madame de Maintenon. Nicholas Foquet, a courtier who borrowed it, was executed. Louis XVI and Marie Antoinette, who inherited it, lost their heads on the guillotine. Princess de Lamballe, of Marie Antoinette's entourage, was killed by a revolutionary mob.

The thieves who stole it were executed or deported to penal colonies. Wilhelm Fals, the gemsmith who cut it down for them, ended his life in poverty. Hendrik Fals, his son, who stole it from the thieves, committed suicide. Francis Beaulieu, last of its underworld owners, who sold it to Daniel Eliason, a London jeweler, died of starvation in a garret in Soho. Lord Francis Hope became a bankrupt, and was scandalized by the elopement of May Yohe, his American actress wife. At last accounts May Yohe was a scrubwoman in Tacoma.

Lorens Ladue was shot and killed by her infatuated admirer as she danced in the glare of the footlights with the diamond on her bosom. Her Russian cavalier, who had hung the jewel about her neck, was assassinated. Simon Montharides, who sold it to Sultan Abdul Hamid, was killed in an accident. Two of its Turkish custodians were murdered. Salma Subaya, the sultan's favorite, was shot while in the Yildiz Kiosk; and Abdul Hamid finally lost his throne.

Imported into the United States, it was bought by Edward B. McLean for $300,000. As beautiful as when, fresh from the mystic East, it dazzled the court of France, the diamond for years brought only happiness to its new owners. Then one day the little son of the McLeans, first-born of a happy marriage and heir to vast riches, was killed at play by an automobile. Instantly the tragic tradition recurred to the public.



A B C D E

The Florentine diamond (*A*), among the crown jewels of Austria, weighs 139½ carats and is valued at $525,000. It is a very pale yellow. It was picked up on a medieval battlefield and sold for two francs. The Hope (*B*), 44¼ carats, is believed to be a portion of a beautiful blue stone of 67 carats cut from a stone weighing over 112 carats, which was discovered in India, brought to Europe by Tavernier, and which was stolen from the French crown jewels. The Hope has the same color as the missing gem. The Kuh-i-Nur (*C*) eventually passed into the hands of the East India Company, and was presented by it to Queen Victoria in 1850. This is a picture of it recut to 106 carats. The Star of the South (*D*), perhaps the most famous of Brazilian stones, was found in 1853. It was cut from 254½ carats to 125 carats, and was bought by the Gaikwar of Baroda for $400,000. The Pasha of Egypt (*E*) weighs forty carats and is valued at $140,000

© Press Illustrating Service

Between these lines lies safety. This is Cincinnati's idea of first aid to preoccupied pedestrians. It's a woman who is ignoring the rule and cutting across the corner

How They Cross the Street in Cincinnati

LINES and feet seem to be indivisibly connected. We have been enjoined, ever since we can remember, to "toe the line." More recently, New Yorkers have been ordered to "follow the black line" and "follow the green line" when adventuring in the subway.

Cincinnati works along still other lines. The city fathers have had lanes marked out by two white lines at the busy crossings, with the legend on the curb-stone, "Walk between the lines." Vehicles do not cross the safety-zone until they are signaled to do so by the traffic policeman.

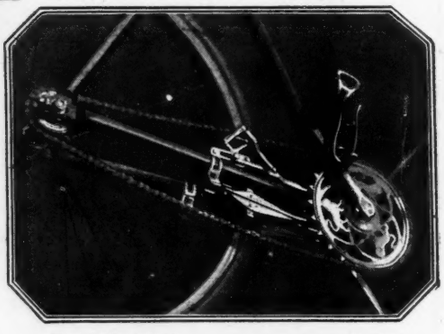
At present the white marks are painted on the pavement, but they are to be made permanent with white bricks.

The Bicycle Gets Its Emergency Brake

SNAP! The brake-band broke and the cyclist shot down the hill at a speed that increased with every second. If his wheel had been equipped with an emergency brake there would have been no danger.

Such a brake was recently invented by a Frenchman. To work it you simply back-pedal. Forward-pedaling keeps the chain tight, while back-pedaling slackens it. The emergency brake has a tooth, which is stationed just below the tight chain. When the chain slackens, one of its links drops over a tooth and pulls it backward as the rider continues to back-pedal. This movement of the tooth affects levers that press on the sides of the rear wheel and act as a brake.

In the picture below you can plainly see the tooth and chain interlocked, while a small bar presses down on the rim of the wheel.



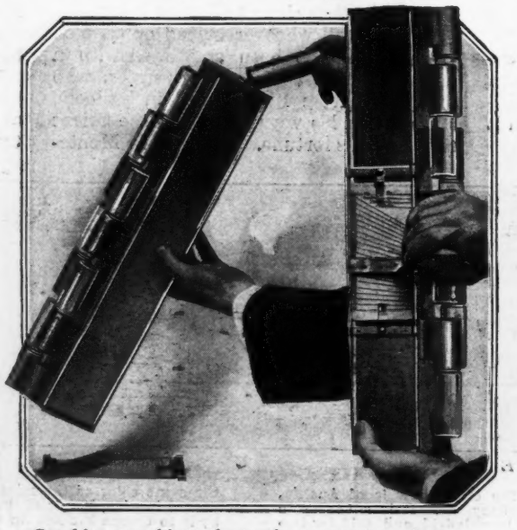
This bicycle has an emergency brake which is worked simply by back-pedaling

This Apparatus Tests Sand on the Job

A SIMPLE apparatus recently invented makes it possible to test the sand to be used in concrete work without sending samples to the testing laboratory. It consists of a rectangular metal box with an opening at one end. By five screens graded as to mesh and soldered to the sides of the box the receptacle is divided into compartments, each communicating by soldered elbows with small glass vials placed in two rows on the outside of the box.

In making the test a measured sample of the sand is poured into the box and shaken through the screens. Then water is added, the opening closed, and by a gentle swaying motion the sand on the five screens is washed into the corresponding vials.

The sand is allowed to settle before the record is taken. The record sheet is fastened to a sliding pad, and on it cross lines are drawn indicating the levels of the sand in the five vials. These lines intersect the index line at certain points and the slanting lines of the percentage scales indicate how large a percentage of the sand passed or was retained by each screen.



Sand is poured into the testing apparatus, shaken into glass tubes through graded screens, and the result recorded on a specially ruled sheet

When It's Clean-Up Day in Poland

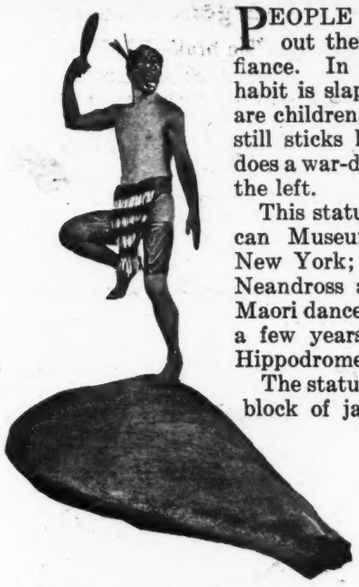
"ALL men, boys, and young girls must have their heads shaved completely on April first." Suppose our government issued this order, how would you like it? Poland has issued this order.

Ever since war broke out in 1914, Poland has suffered severely from typhus. The hair-cutting order is simply part of an extensive campaign for wiping out the disease. On the same day that their hair is cut, the victims must also take a bath.

The campaign will last for three months and each village is assigned a clean-up day. The people are also supposed to disinfect all bedding and clothing on that day. Health authorities point out that if typhus is not stemmed in Poland it will soon spread to all western Europe.

Poland will need for her general clean-up one hundred physicians, one thousand steam disinfecting machines, eight hundred thousand pounds of cresol, and three hundred tons of soap.

A War-Dance on a Block of Jade



PEOPLE the world over stick out their tongues to denote defiance. In civilized countries this habit is slapped out of us when we are children, but the Maori warrior still sticks his tongue out when he does a war-dance—note the statue at the left.

This statue is found in the American Museum of Natural History, New York; it was made by Sigurd Neandross and was posed for by a Maori dancer brought to this country a few years ago to dance in the Hippodrome.

The statue is poised on the largest block of jade known to exist. It weighs three tons, and is seven feet long and four feet wide. Both the dancer and the jade came from New Zealand.

The largest block of green jade known to exist has mounted on it the statue of a Maori warrior

This decoration in front of the window is a willow root that grew within a water-pipe and gradually cut off the water supply

Watch Out for Willow Roots

HANGING up in front of the Water Department of the village offices at Lakeville, N. Y., there is a twenty-four foot willow root. And the Water Department keeps a careful eye on it, for it is a trouble-maker—last year it very nearly cut off the city's water supply.

Here's how it happened. Twenty years ago a wooden plug was driven into the pipe and a small tendril from the root of a willow tree near by got mixed up with it. This tiny root grew rapidly within the pipe and gradually choked off the flow of water.

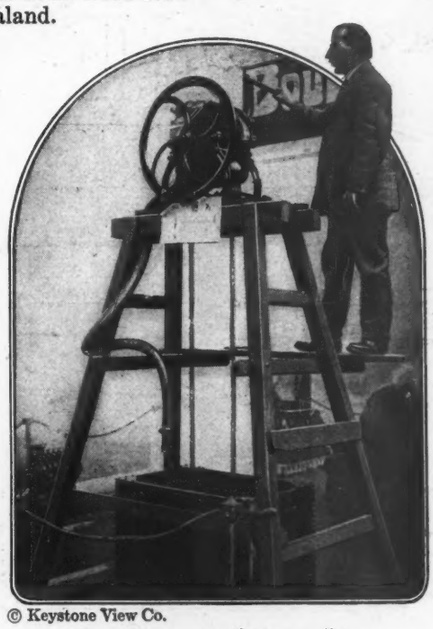
The Water Department naturally thought there must be a leak somewhere. Three men were sent out to find it: instead they found twenty-four feet of willow root clogging the pipe.

To remove it a section was cut from the pipe and a strong rope fastened around the head of the root. It took three men to pull it out. The root is now supported by three hooks on the window of the village offices, and the admiring natives visit it regularly.

This Pump Is Called a "Mechanical Impertinence"

WHEN an eminent British scientist saw this pump at the Dairy Show in London, he was so astonished by its simplicity that he laughingly called it a "mechanical impertinence."

The water is drawn up by an endless chain enclosed in close spiral coils. The chain is weighted at the immersed end by a grooved wheel. At the upper end the chain rests in the groove of another wheel, which may be rotated by hand or by motor. As the chain is drawn through the water the liquid fills the space between the links and the coils of the spiral and is held there by capillary attraction until it is released by centrifugal force as it is whirled around the driving wheel at the top. The length can be adjusted.



© Keystone View Co.

It pulls up water by an endless chain surrounded by a spiral coil which holds the liquid by capillary attraction

Oscar Duffy, aided by his two sons, is making molasses in a homemade mill out of sorghum grown in his own back yard

Grow Your Own Molasses

WHEN food was scarce here because of Europe's need, people grew food in their back yards. Now that sugar is scarce, why not grow sugar-cane there? Mr. Oscar C. Duffy, of Springfield, Ohio, tried it, and now he has twelve gallons of sorghum molasses in his cellar.

It was not the sugar-cane of the sunny South that Mr. Duffy grew, but Chinese sugar-cane or sorghum, which is hardier than sugar-cane and comes to maturity in one season. It is a cereal and the sugar is in the stem.

When the sorghum was full grown, Mr. Duffy found that there was no mill near by to which he could take it. What did he do? He built his own mill, which he operated with the help of his sons. He made the mill out of two wash-tubs, a clothes-wringer, two four-inch rollers, and several planks.

He crushed the stalks between the rollers and the juice and pulp fell into one tub. Next he ran the pulp through the clothes-wringer and extracted more juice. He boiled the juice in a wash-boiler and molasses was the result.

These Are the Real Money-Makers

They are turning out pennies galore so that we'll all have enough to pay our war taxes

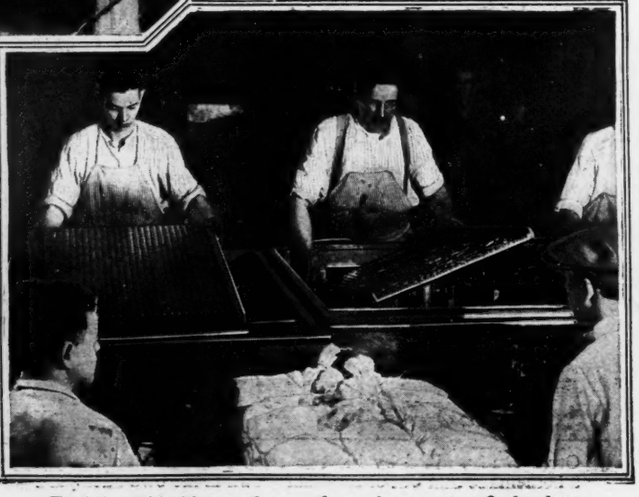
Photographs © International Film Service

Sixty million pennies are turned out in one month and a great many of them pass through this tray on their way to the stamping-machine; the white-haired lady inspects the disks and picks out those that are imperfect

Pouring the disks in the stamping-machine, where they are molded into final shape

The long strip of copper being fed to a punching-machine in which disks are punched out at the rate of one hundred and fifty a minute

The finished coins scooped into scales and weighed in large quantities to determine the gross number turned out, the number of pennies to the pound being known. There are about seven hundred dollars' worth of pennies in the scale now



Each board holds one thousand pennies, a penny fitting into each slot; when all the slots are filled the pennies are dumped into a bag, ready for distribution. The Mint at Philadelphia runs night and day to supply the demand

Prohibitionists and "Antis" Take Notice

How much water is used for personal purposes by the American people? We mean for drinking, bathing, cooking, and washing. Statisticians say that the average family contains three members, and that each family uses an average of 90 gallons a day. Hence each member of a household uses 30 gallons a day. Now, the present population of continental United States is approximately 105,000,000. The total consumption of water for household and personal use amounts to the enormous total of 400,000,000 cubic feet daily. What has all this to do with Niagara Falls shown at the right with an enormous water faucet turned on full? Just this: the daily consumption of water in the United States is enough to keep a Niagara Falls going for the period of thirty-five minutes

A ship afloat displaces an amount of water equal to its own weight. Thus the *Leviathan*, with a tonnage of 50,000, displaces 1,600,000 cubic feet of water. It would take 250 such giant steamers to displace the quantity of water that the American public is said to consume every day

The operator of this mechanical semaphore spells out his messages by pressing down levers representing the letters of the alphabet

Signaling on a Keyboard

THE man in the little house on the roof is not ringing chimes, nor is he playing the calliope or setting switches in the railway yards; he is operating a semaphore of an improved pattern, spelling out the letters of a message to a distant observer.

The man who signals with flags or who uses one of the numerous mechanical signaling apparatuses heretofore tried, must go through a course of training before he can safely be entrusted with sending or receiving messages. With the apparatus shown in the picture anyone who is capable of reading can send messages.

Each lever represents one of the letters of the alphabet. The levers are arranged like the keys of a piano or a calliope, all being pivoted to the same stationary rod or bar fastened to the wall of the cabin. Each of the two blades of the semaphore is connected by a rod with one of the two parallel cross-bars shown in the picture. These cross-bars are pivoted at one end, while the other end has a rack-and-pinion connection with one of the semaphore arms in such manner that the arm is raised when the corresponding cross-bar is depressed.

On their lower edge the key levers have notches which engage the cross-bars. These notches are so gaged that, when the key lever is pressed down to the stop, the cross-bars will be depressed so as to bring the semaphore blades to the position representing the letter of that particular key. When the key lever is released, the semaphore arms are snapped back to their original position by powerful springs.

In Behalf of Window-Washers

NO one likes to wash windows. If you sit or stand outside you run the risk of falling. If you work from the inside you must go through contortions in order to reach the center point on the outside of the lower window-pane. Is there no remedy for this?

Yes, says Alexander Kuneman, of Erie, Pa.; for he has invented "new and useful improvements in windows" distinctly for the purpose of facilitating window-washing. The lower sash is mounted so that it will swing, and the upper one may be lowered and fastened to it so that the two will swing together. When you wish to wash windows you swing the two sashes into the room and do your washing in comfort. When the upper sash has been polished, slide it back into place. The lower sash may then be swung in alone, and given its turn at the chamois.

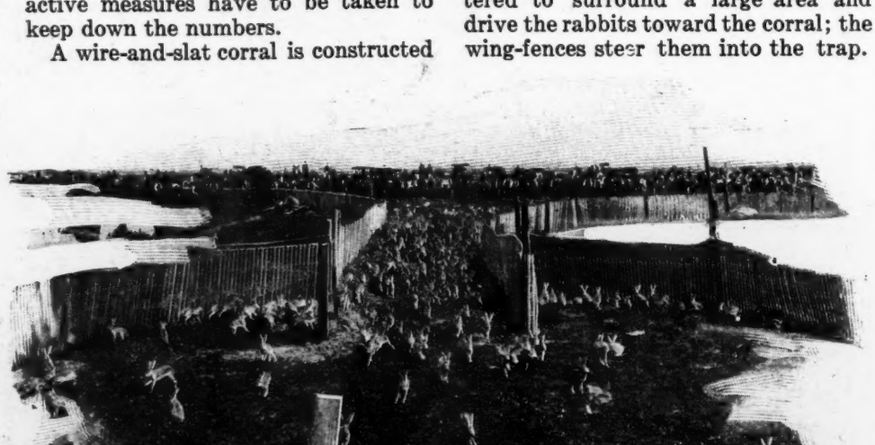
When you wish to wash this window you simply swing it into the room

It is a well-known fact that unionized window-washers make more money than most college professors. But window-washing is a dangerous job, particularly when the window in question is on the fortieth floor of a building.

War on the Jack-Rabbits

JACK-RABBITS multiply so rapidly that their depredations on growing crops frequently become a real menace. In many parts of the Middle West active measures have to be taken to keep down the numbers.

A wire-and-slat corral is constructed at some central point. From the entrance long wing-fences extend in a wide V. Every available man, woman, and child in the neighborhood is mustered to surround a large area and drive the rabbits toward the corral; the wing-fences steer them into the trap.



At the end of a perfect rabbit drive. These organized drives not only free the district of crop-destroyers, but provide a considerable source of food supply

She Carries Passengers Instead of Bombs

The new giant Zeppelin "Bodensee" can never be used in war

By Carl Dienstbach

WHEN recently the Hamburg-American Steamship line resumed its aerial passenger service, having built a new dirigible for the purpose, the agreeable fact became evident that this up-to-date Zeppelin was inherently a peace craft and could never be converted into a war craft. This new vessel, named the *Bodensee*, cannot navigate the air unless it carries its quota of passengers or an equivalent in ballast, which may neither be dropped nor consumed. This is due to a boldly novel distribution of weights.

The crew of the great passenger Zeppelin *Bodensee* is lined up alongside of the cabin; the *Bodensee* will accommodate fifty passengers

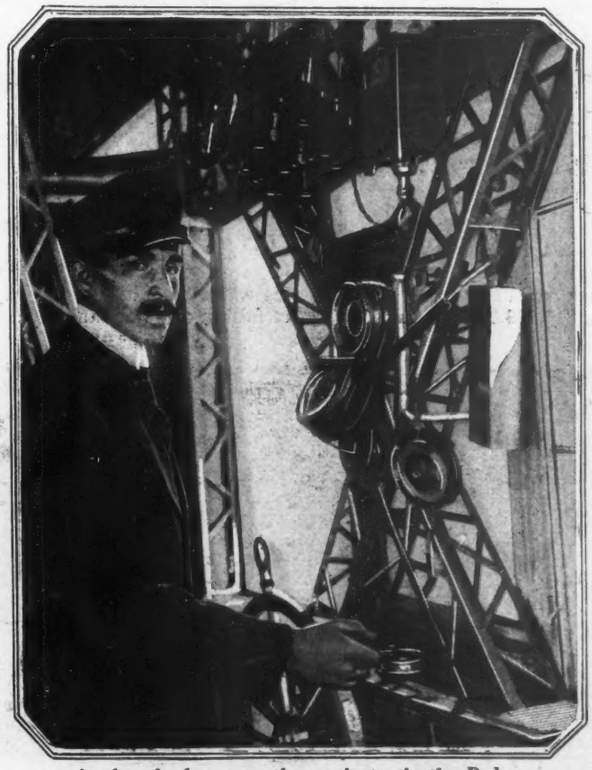
In former ships the passenger cabin was located, like the observer's seat in an airplane, at the center of gravity, where, full or empty, it could never disturb the balance. On the new ship the cabin is at the front end, ideally located for comfort and aerodynamical considerations, but out of balance when the Zeppelin is empty.

Suppose bombs or additional fuel for sea cruises were loaded into that cabin. The bombs could not be dropped because in that case the elevators would be so taxed in forcing the nose down against its sudden lightening that they would become unfit for other use. Letting out gas in front only would be too slow a compensation. This trouble is radical and inherent, because it could be remedied only by an entire redistribution of the fixed weights behind, which in turn would demand reconstructing the hull.

But let us discuss the peace possibilities of this design. To combine the navigating cabin in front with the passenger cabin is ideal. It insures in the whole front part the cleanliness, splendid repose, unlimited view, purity of air, and absence of fire danger of a spherical "free balloon." Navigating instruments and wireless are doubled in efficiency, the officers' nerves are saved by the remoteness of the engines and the proximity of comfort and a "mess" and pantry. Air resistance is splendidly reduced by the well proportioned long, smooth structure of this united cabin—the absence of fire danger making it possible to place the cabin tightly against the hull, giving direct access to its "hold."

Attention should be called to the glazing over of all the many windows necessitated by modern speed—in place of the "gaping holes" in the old cabins. The three engine-rooms are far behind, transmitting not a particle of vibration or noise, yet under instant control by telegraph and telephone.

The final and most telling plea of this craft for peace is in its size, preventing war altitudes. It is not at all a "super-Zeppelin," not even an old-fashioned naval Zeppelin. It accommodates fifty passengers and will reach Berlin from Lake Constance (that is, crossing three fourths of the German territory) within four and a half hours. The train takes fourteen hours. Passenger Zeppelins now call for a revision of established ideas on travel. All Europe is as easily within their direct range as the nearest fifty miles are to the owner of a Ford.



At the wheel you see the navigator in the *Bodensee*, a Zeppelin that makes regular passenger trips and belongs to the Hamburg-American Line

The completeness of commercial success of the resurrected peace Zeppelins may best be gathered from a statement made by an American lawyer who recently returned from a business trip through central Europe. He said that he would have "taken the Zeppelin" from Munich to Berlin if the day in question had not been the day of the Berlin-Friedrichshafen trip. It costs but one hundred marks to ride on the *Bodensee*.

You may remember the recent account of the accident which befell the *Bodensee*. She was landing in a high wind when suddenly she broke away and disappeared in the night. Her front gondola was smashed and one of her engineers was killed. She landed safely the next day several miles away. The men who helped her try to land were really responsible for the accident; they were friends of the passengers and knew nothing of the skill necessary in order to land a Zeppelin safely. It is just as hard to dock an airship safely as it is to dock a ship.

The Banjo of a Thousand Pieces

A BANJO made up of fourteen hundred and thirty-four pieces has traveled over sixty-four thousand miles in the last fifty years—and has never lost a piece.

The banjo with this record is studded with bits of pearl, ivory, and colored wood, in all shapes and sizes, and was made by its owner, Joe Patterson, of Eastport, Maine.

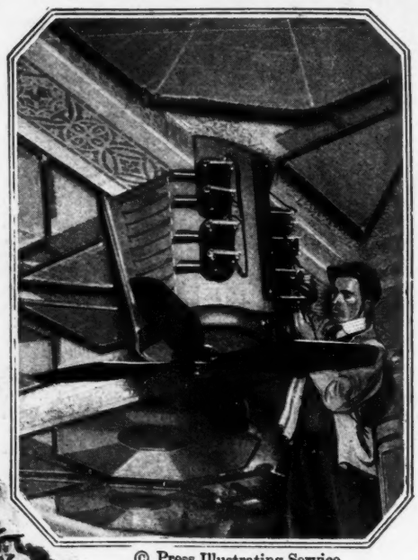
Joe Patterson is a wandering minstrel and one of the veterans of the old-time minstrel days following the Civil War. Although he is now sixty-six years old, he is still an active black-face comedian.

Women Jockies Come Next

SO far as we know there are no women jockies yet, but there may be a thriving crop of them before long. In England, at any rate, where women are busily upsetting all sorts of ideas about their "place," women have been replacing stable-boys in exercising race-horses, and, as everyone knows, every stable-boy who has a leg up at exercise time hopes to graduate soon into a full-fledged jockey.

The daughters of Sir Robert Wilmot, owner of a large racing stable in England, have shown the way, and the trainer says that they have unusually light and firm hands and that the horses appreciate the change from stable lad to stable lassie.

© International Film Service



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A Room Designed to Attract Aviators

WHIR! The aviator drinking tea in the Hotel Imperial looks up with a start. Surely it is an airplane's motor that he hears! And then he sees it projecting out of the ceiling, while its propeller whirls the air about.

No, the airplane did not crash through the roof. It was placed there purposely by the owners of the hotel. They had decorated the entire room with airplane parts in order to induce aviators to patronize the hotel. The engine hood, with its radiator and propeller, act as a fan as well, and cool off the air in warm weather.

When the engine needs cleaning the mechanic must stand on a ladder to get at it.

Inviting Guests with Bricks

YOU have heard of bricks being used to speed the parting guest on various occasions—usually when there has been a difference of opinion during the visit. To invite guests with bricks, when one is doing so in all good faith, is a new idea. However, it was done, and the party turned out to be a great success.

Each one of the bricks was wrapped in brown paper and sent out as dinner invitations, via parcel post, by the Campaign Committee of the United Building Campaign Fund. As a result of their efforts in this and other ways, $10,000,000 was raised.

He Pedals as He Peddles

SPONGES, feather dusters, carpet-beaters, dust-brushes, and wicker baskets are light things to carry, though clumsy. A Dutchman decided to peddle them, and instead of buying a flivver or a horse and wagon, he used his bicycle as a delivery wagon.

He hung hundreds of sponges on the left side of his front wheel, and many bags and brushes on the right side. In front he spread the baskets, and over his shoulders more bags. Though his wares may very easily trip him up, he at least will be sure of falling on something soft.

© Keystone View Co.

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A Boy at the Tread-Wheel Irrigates the Fields

EACH country has its own ideas on irrigating dry fields. In China, for instance, it is sometimes done in the peculiar fashion shown above. A water-wheel is mounted in a small stream at right angles to the flow of the current. The water won't turn it over and so a small boy does it tread-wheel fashion.

He holds on to a pole sunk in the water, and pushes the wheel around by stepping on to the ends of the blades. The water is then forced through a trough leading to the fields that need irrigating.

One way to develop a Marathon runner —but pretty tedious after the first hour!

It Was Here Before Columbus

ON a farm near Rosewell, N. M., is an irrigation ditch, or rather a raised irrigation canal, which is one of the oldest evidences of man's inventive powers on this continent. It was built centuries before Columbus learned navigation. The walls of the canal are believed to have been made of sediment taken from a near-by spring, a clay-like material that exposure to the air has made as hard as stone.

The making of two blades of grass to grow where but one grew before through irrigation is a very ancient practice. It was carried on crudely by the Egyptians at least as early as 2,000 B.C.

When You Walk the Ladder Step Goes with You

THERE is now a ladder that has just two steps, one for each foot. As you climb you take the steps with you. There is a pocket in each step into which your foot fits snugly.

The slots along the sides of the ladder in which the steps slip up and down are provided with ratchets that will hold the steps in a fixed position whenever you press down on them. Thus by dragging one foot after the other you can adjust the steps to suit yourself.

How do you get down again? We are not quite certain, but we presume that you reverse the action.

Selling to the Man Higher Up

"ICE cream cones, five cents each!" shouted the small boy standing alongside of the bus. Several passengers on the upper deck looked down longingly at the tray of cones below, when, behold! the tray of cones shot up within their reach. The boy had mounted his tray on a long pole in order to get the trade of the men and women higher up—and he succeeded.

While the bus riders waited in the hot sun for the bus to start they fell easy victims to his plan. And he gathered in the nickels. Or perhaps he charged a dime. Ice cream, like everything else, has become more expensive, and besides, this boy's business is a risky one. Ice cream melts quickly in the hot sun.

Should two or three bus loads pass him up, the ice cream in his cones would run down into the tray and the result would be a total loss.

When this picture was taken there were just four cones on the tray, and eight people on top of the bus. His chances of selling out seem good.

© Gilliams Service

No Smuggling on the Rhine!

PUT! Put! Put! Put! The modern watch on the Rhine pricks up his ears. A launch is running without lights somewhere in the river. He passes the word, a searchlight begins to feel around in the velvety blackness, and a launch flashes into view as the brilliant beam picks it up. The sentry hails the boat, but gets no reply. Instantly a rattle of machine-gun shots rings out on the night air, and the boat stops.

The combination of machine-gun and searchlight was invented by the British forces to break up smuggling on the Rhine. When the light plays on an object the gun is automatically trained on it.

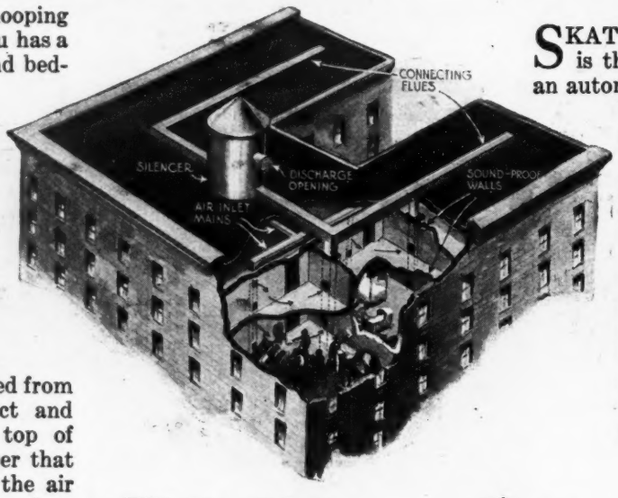
The gun and the searchlight are mounted side by side on a common stand and turn on the same axis. When the searchlight is turned about to pick up a boat, the gun moves with it. When the boat is spotted, the gun is ready for action, if necessary.

Here's Maxim's House of Silence

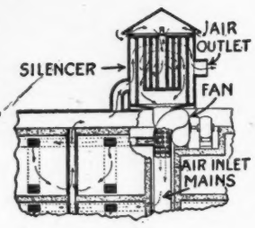
THE baby below you has whooping cough; the man above you has a pianola; and both tune up around bedtime.

But Hiram Percy Maxim, the well known inventor of the silencer for firearms, has come to the rescue. Be not alarmed, he does not intend noiselessly to shoot your neighbors, but to apply his silencer idea to the apartment-house itself. He would build apartment-houses, hospitals, and hotels so that the windows need never be opened. Air is furnished from the roof through a main duct and several branching flues. On top of the main duct there is a silencer that breaks up the noise waves in the air which is entering. As it goes into the silencer it passes through a series of spirals which are enclosed in an inside chamber made of sound-deadening material. By the time the air finally reaches the main duct all the noise has been taken out of it.

In the duct there is a fan for forcing the air down and a coil for heating or cooling it. In winter the coil is filled with steam and in summer it is filled with a refrigerant. The fresh-air openings are near the ceilings of the rooms and the flues for carrying off the foul, used air near the floors.



With the windows closed and the air coming through a silencer on the roof, you will not hear your neighbor's pianola or his baby



As noise waves enter the silencer, they pass through a series of spirals enclosed in a chamber made of sound-deadening material

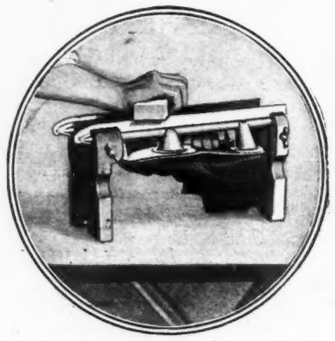
Why Not Sharpen Your Own Skates?

SKATES dull easily and the result is that you skid on the ice just as an automobile does on wet pavement

Every skater should own his own sharpener.

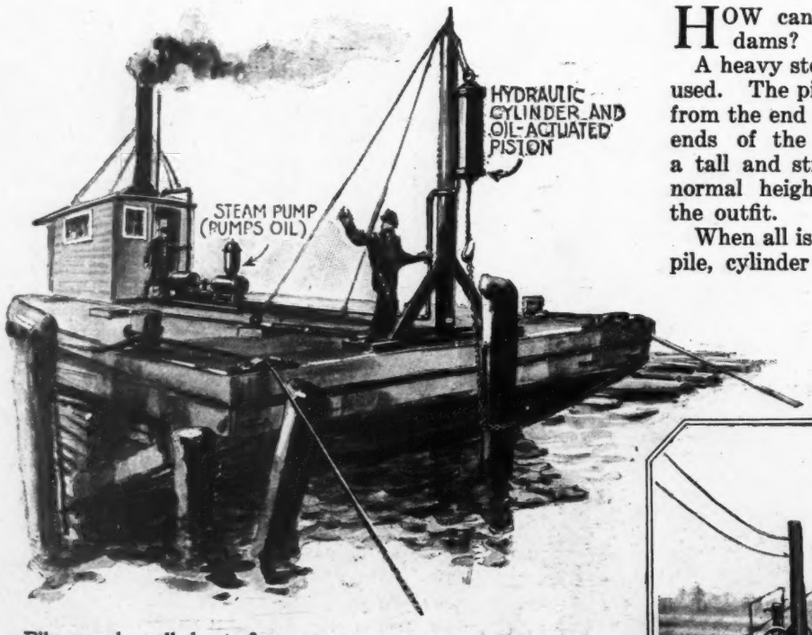
The picture below shows an individual skate-sharpener that has recently been invented.

To use this skate-sharpener, first turn your skates upside down and fit them into grooves in a small wooden stand. Tighten them in place by means of screws, and then rub the upturned edges with a sharpening bar.



Sharpen your own skates as easily as you shine your shoes

Sheet Piling May Be Pulled Out by Hydraulics



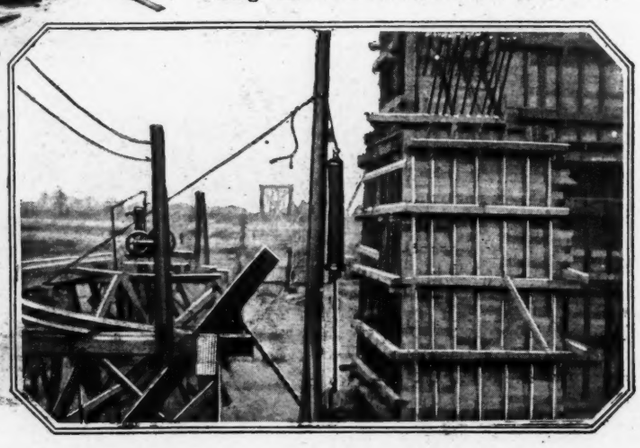
Piles may be pulled out of deep water by mounting pump and spar on a scow. The device has a lifting power of eight tons

HOW can you pull out sheet piling used in coffer-dams? One ingenious method is shown herewith.

A heavy steel cylinder with pipe fittings and piston is used. The piston-rod, with a hook on the end, protrudes from the end of the cylinder to engage the holes in the ends of the sheet piles. The cylinder is attached to a tall and strong spar at a height sufficient to reach the normal height of the pile-holes. A pump completes the outfit.

When all is ready, with the hook engaging the eye in a pile, cylinder oil is pumped into the lower end of the cylinder, and the piston pulls the hook upward.

With eight tons of lifting power the device is capable of moving almost anything that can be driven.

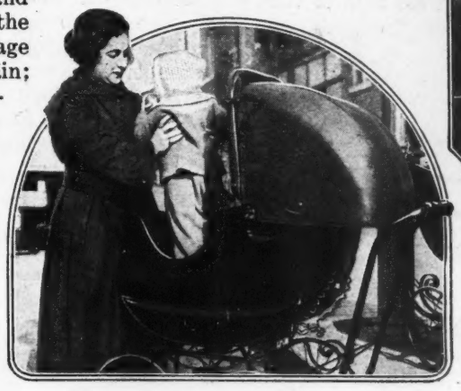


The small cylinder attached to the spar will pull up sheet piling; a piston in the cylinder has a hook on the end that fits into the eye in the pile; oil is pumped into the cylinder and the piston easily pulls the pile up

Put a Burglar Alarm on Your Baby

KIDNAPPED—not by Stevenson but by a burglar; many mothers are constantly in fear of having this happen to their babies. They always keep a watchful eye on the baby-carriage. Why not attach a burglar alarm to baby and carriage? This has been done, as you will see if you look at the picture below.

Fastened to the carriage just below the handle there is an electric bell with wires running down from it to a battery below. When the mother leaves her child she sets the alarm. Along comes the burglar. Should he start to wheel the carriage away the bell will ring loud and long. Or should he notice the alarm and decide to remove the baby from the carriage he will be foiled again; the alarm is also attached to the baby.



No one can steal this child without setting off an alarm; the alarm is attached both to the carriage and the baby

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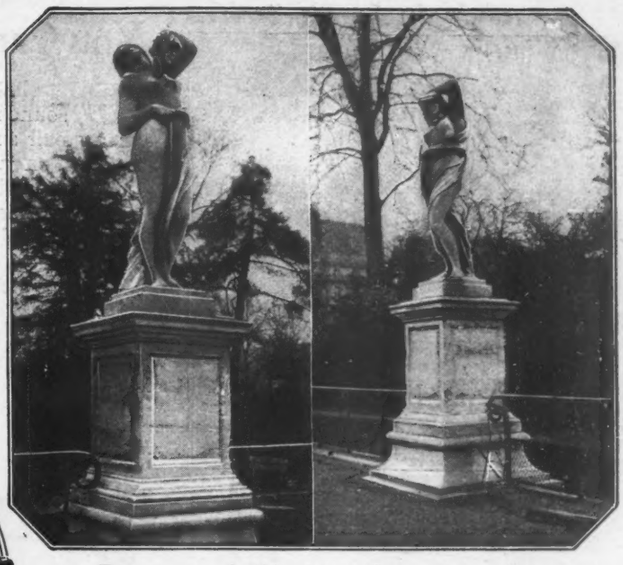


From one angle this statue of a woman smiles at you derisively; from another you see the mask torn off and face and body tense with anguish

Turns Two Faces to the World

AS you walk through the Garden of the Tuileries in Paris, you come upon the statue of a woman who slouches carelessly on her pedestal and looks down at you with an unpleasant, derisive grin. But if you walk around her you will see the real woman with the mask torn from her face.

Her head is thrown back in anguish, her teeth clenched, and her eyelids drooping with pain. Her body is no longer slouching but tense. She holds the mask in her left hand.

This remarkable statue was first made in clay sixty-five years ago by Ernest Christophe, who called it "Sorrow."

Twenty-one years later Christophe remade the statue in marble and gave it a new name—"The Mask."

Bats Made of Wood Strips and Glue

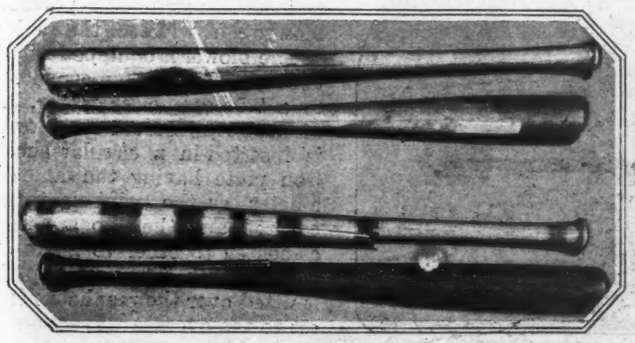
A NEW baseball bat, bidding fair to make its appearance in major baseball, has been developed at the Forest Products Laboratory, Madison, Wis.

It is made by gluing together strips of wood obtained from board edgings and waste stocks. The strips are selected to give clear material and are dressed to a smooth surface before being glued together. The moisture content is also equalized. The laminations may vary in thickness from a half to three quarters of an inch.

The photograph below shows several bats made by gluing together three laminations, three quarters of an inch thick and two and a half inches wide. Two bats, as shown in the picture, failed while being used.

In both cases the failure occurred in the wood, while the glue held unbroken, even under the severe pounding the bats received.

The laminated bats seemed to give as good service as the solid bats on the field, and the players showed no preference for one kind over the other.



These bats were made by gluing together strips of wood; in the two imperfect bats the wood cracked—not the glue

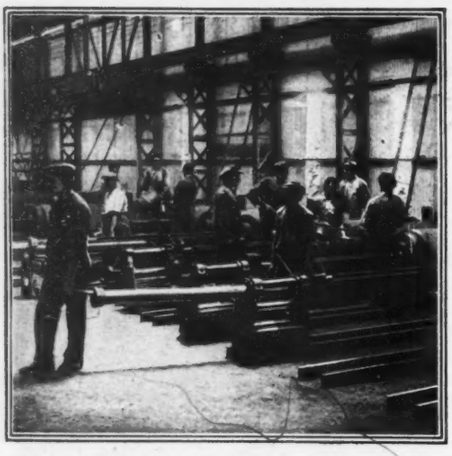
Here is a collapsible stove for campers. The grate is mounted on a rod and opens up umbrella fashion

Here's a Stove that Opens Up Like an Umbrella

"LET'S go camping—build a fire in the woods and cook our dinner on it," someone says. And then you remember how last time somebody kicked the log you were using to prop the coffee-pot, and over it went—just as it was going to boil, too. And you jumped to save it, and tipped over the frying-pan, and its contents were unfit to eat. "No! Give me a good steady stove at mealtime," you reply.

Now Roderick D. Turner and Walter G. Dedolph, of Mount Vernon, Washington, have together invented a camp-stove that is the very thing you need. When not in active service it can be folded up like an umbrella and carried just as easily.

A central rod is driven into the ground and supported by a tripod that has adjustable legs. Mounted on the central rod is a collapsible grate that may be opened up and flattened out. You rest your pots upon it. The grate is supported by wires from the central rod. The whole stove weighs but ten pounds.



Hot iron is poured into these machines and whirled into pipes by revolving molds

Whirling Molten Iron into Pipe

IF you whirl a string with a weight on the end and then let go, what happens?

It flies off at a tangent. This is caused by what is known as centrifugal force; and the same principle is applied to many pipe-casting machines.

The hot iron is poured into the machine, and it lands on a whirling steel mold that is properly cooled.

The liquid is flung against the sides, hardens, and comes out a perfect pipe. The pipes that are made in this way are of uniform thickness, and, though thin, are very strong.

How Will You Have Your Gas?

JUST as we get expert in sight-reading the gas-meter, along comes an Englishman with a new scheme for measuring the gas we burn. He proposes that it be sold by heat units instead of by the cubic foot.

This doesn't mean that the gas-meters will be scrapped. They will go merrily on registering cubic feet, but in order to understand your bill you'll have to translate that into heat units.

To do this you have only to remember that the unit of heat measure is the quantity of heat required to raise a pound of water one degree Fahrenheit. If, then, when Polly puts the kettle on it contains two pints of water, it will require 380 heat units to bring the water to the boiling point—212° F. It is proposed that the new "gas unit" shall contain 100,000 such thermal units, so that one "gas unit" will have sufficient heat to boil two hundred and sixty such kettles as Polly put on.

You Can Tuck This Piano Under Your Arm

"OH, what a pal was Mary!" sounds just as convincing on a small sixty-pound piano as it does on a baby grand—particularly so since the tone of the new small piano is harp-like, and Mary is dead.

What does this tiny piano look like? The picture below will show you.

It is so small that soldiers at the front were able to tuck it away in their equipment and take it out whenever they had a few hours' rest. The piano has a regular five-octave range, but tuning-forks instead of strings are used to produce sound. This, of course, does away with the necessity of tuning the instrument.

When you strike a key, a hammer drops on a tuning-fork, which is set to vibrating and produces a tone.

The fork is connected by a spring to a sounding-board that reinforces the tone.

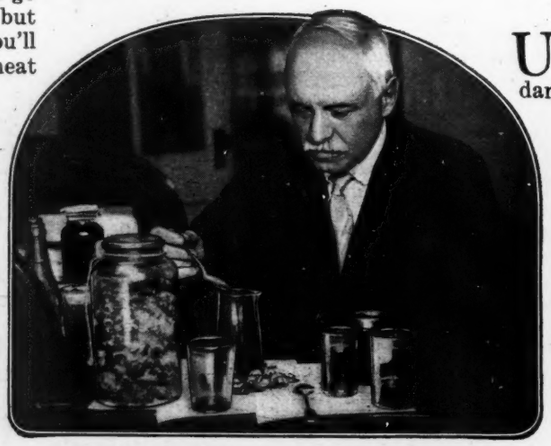
The piano is also equipped with a loud pedal. When you step on it a damper that rests on the end of one arm of the fork is raised, and the fork is free to vibrate loud and long.

This tiny portable piano weighs but sixty pounds; it has a full five-octave range, but the tones are produced by tuning-forks instead of strings

Saving Fallen Fruit

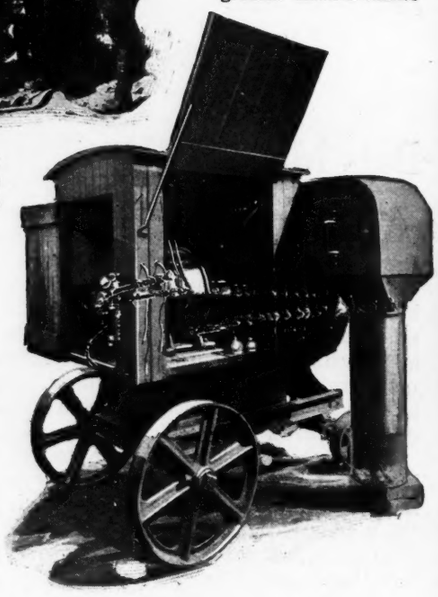
WHEN a strong wind blows, a large number of lemons, oranges, and grapefruit that are nearly ripe drop to the ground. Many are bruised, and many more are instantly attacked by ants and worms. The fruit is a total loss unless quickly gathered.

If they are picked up promptly, the uninjured parts can be turned into by-products. The lemons can be used to make lemon oil, citric acid, citrate of lime, and dried lemon peel; the oranges will yield vinegar, marmalade, syrup, and orange butter much like apple butter; the grapefruit, juice and marmalade.



He is testing out by-products made from bruised lemons, oranges, and grapefruit

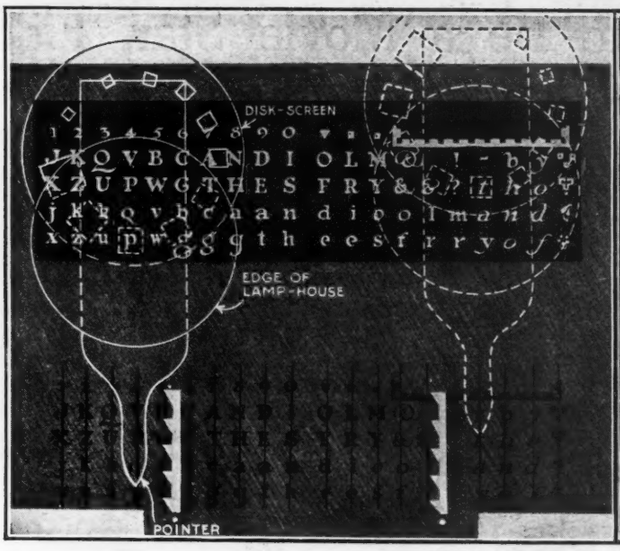
Constructed to cool off overheated underground electric cables



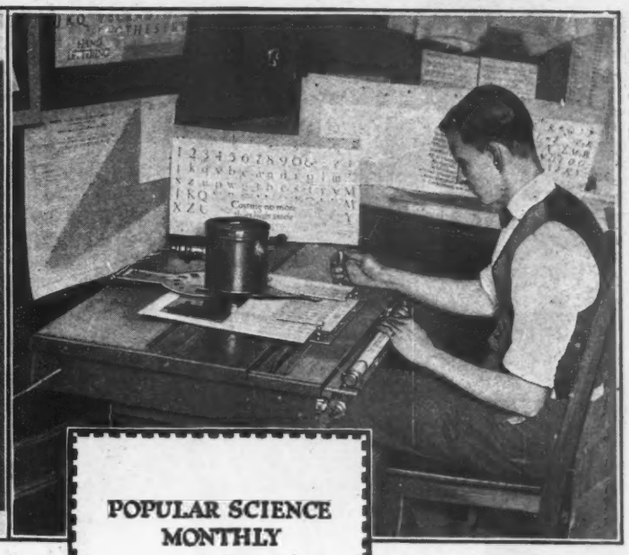
Cooling Off Underground Electric Cables

UNDERGROUND electric cables frequently become heated to the danger point. A company in Detroit has constructed a portable blower that will cool the cables.

The blower is equipped with a twenty-eight-inch fan connected to a 7.5-horsepower motor. A discharge pipe from the blower is inserted in a circular sheet-iron plate having the same diameter as the manhole to be covered, and the two are then cemented together to make an airtight joint. The circular plate is fitted over the manhole nearest to the overheated section of the cable, and the motor is started.



The upper part is an ordinary film negative upon which has been photographed an alphabet of type. The lower section serves as a guide for the pointer, the upper part being covered by the lamp-house when in use



The operator prints letter after letter by simply moving the negative and pulling a lever. The display card on the left demonstrates that the machine allows as great latitude in the spacing of letters as does hand work

POPULAR SCIENCE MONTHLY

Science
Engineering
Mechanics
Invention
Automobiles
Radio

Hand Lettering by Machine

WHILE printers may readily set up advertisements and cards on linotype and monotype machines, it has always been difficult to prepare those displays which are to be photographed on copper and run as a solid block—a half-tone engraving. It is to fill this missing link that Isaac Bunnell of New York has invented the desatype.

The machine does lettering, the same sort of lettering that an expensive artist does, and in about one tenth the time. Moreover, its range in style of lettering is much greater than the ordinary artist possesses, for, in fact, it uses the best work of all artists. Practically anything that a graduate professional can do, the machine can do, and keep it up in unending variety all the day long.

The operator first clamps a rough dummy layout on a platen at the point shown in the illustration. Then from his file he selects the type-card which carries the style of lettering called for in the dummy. These type-cards are negatives, and a complete set of them, like fonts of type, contains the various sizes and styles of letters. The selected card is put in the machine and moved around until the letter desired, "P" for example, falls under the index, or pointer. The operator then knows that the "P" on the film part of the type-card is under the lamp-housing, ready to print.

Pulling on a short lever at his right, the operator causes the lamp within the housing to light up and send its rays down through the clear place in the negative and so print the letter the clear place corresponds to—suitable sensitized paper being mounted on a roller beneath the lamp-housing in such a way that it can be affected properly by the oncoming rays. Adjustment of another lever sets the apparatus over one space, ready to print the next letter, and in this way the process continues. An automatic timer on the lamp gives each letter equal exposure.

After the printing of the layout is completed, the part of the sensitized paper used is torn off its roll, and developed and fixed just as ordinary "slow" photograph prints are handled. Immediately the black lettering stands out on a white background, just as if a professional artist had done it.

How They Are Chasing the Rats Out of England

ENGLAND'S full of them —the black Irish rat, the brown Alexandrine rat, the common brown rat, and ye olde English black rat. As a result England has had a rat drive, scheduled to last a week —the week being officially called "Rat Week." Besides using traps and poisons to get 'em, ferrets were put on the job. Here you see three ferrets ready to start on a tour through a huge woodstack at Aldershot.

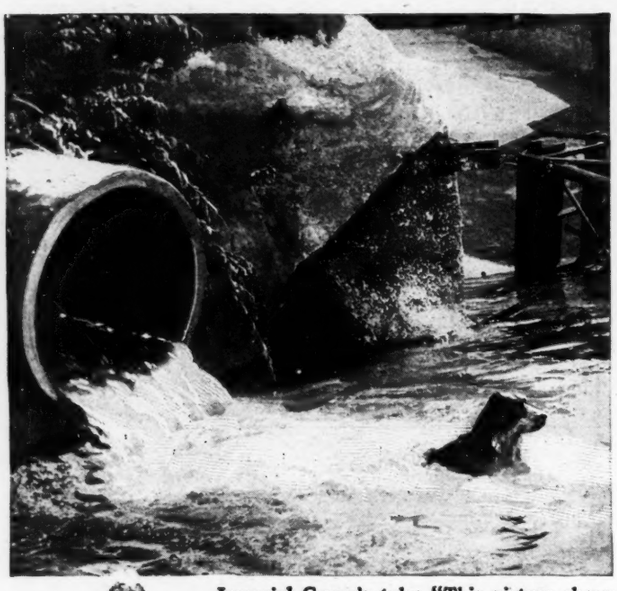
This is, briefly, the history of England's rats: until the first half of the eighteenth century the old English black rat reigned supreme; but then the common brown rat invaded the country, coming by boat from somewhere in Central Asia, and bringing with it the bubonic plague. This fierce little animal nearly exterminated its black brothers.

The brown Alexandrine rat was imported later. As for the Irish rat, it is a black variety of the common brown rat and is not seen very often. Whether native or foreign, rats are great disease-carriers as well as voracious guests at the nation's table.

During "Rat Week" in England, ferrets were set on the trail of many rats; those shown here are ready to tour through a woodpile

Want to Be a Movie Star, Fido?

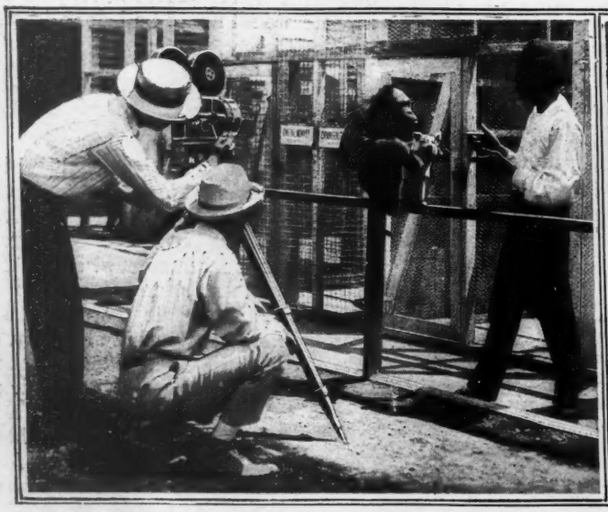
Says Joe Martin, orang-outang: "Follow master—that's my motto; I copy everything he does. As you see, today, instead of acting, I'm the camera man; by being able to help out in a pinch, I have made myself quite valuable—and really these men's jobs are simple"



Imperial Cæsar's tale: "This picture shows —that's what the public think. I'm the confess I think my success is due not to my

Murphy, Edwin Earle's pet, tells us this: "I'm not an actor and don't want to be one, yet my master insists on featuring me—so sometimes I nip better than trousers"

"Ours is the ideal life," these four will tell you. "We never fight and we aren't at all jealous of each other—that's why we succeed"



Here's Joe Martin again; he's going to give the baby pig a bath under a hydrant spout. Joe says, "Curly Stecker has really taught me nearly all I know; he is a very good trainer: but then, you know, I film well"

Says Kazan: "I am a full-blooded Russian wolf-hound and thank my parents for my beauty—I might have been a cur! Good looks do help in the movies, but I have incidentally cultivated a most fascinating smile"

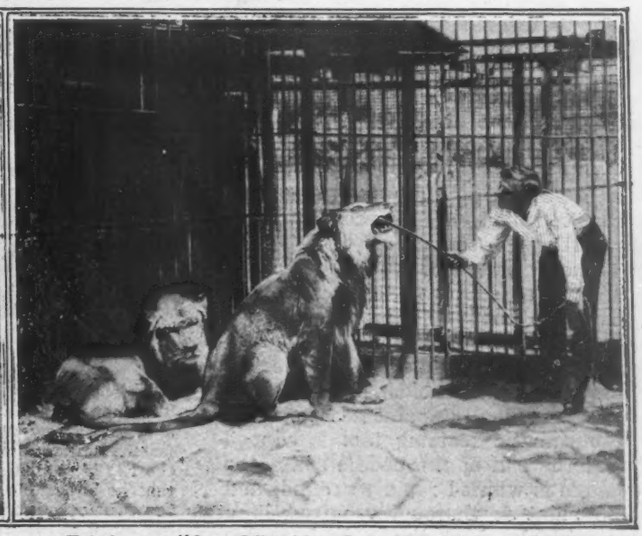
We'll Tell You How to Do It

me struggling for life in a swirling torrent
hero in 'The Eternal Triangle,' and I
histrionic ability but to my good looks"

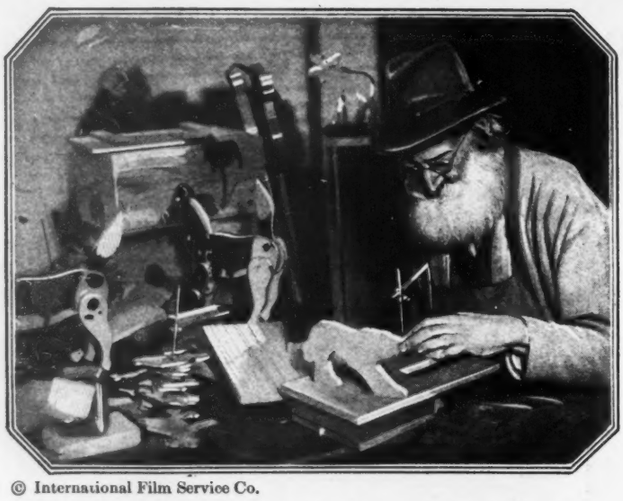
Here's baby tiger's tale: "We tigers have fierce reputations and nobody loves us; but that's no way to make a success in life. Consequently when Enid Bennett pets me, I purr sweetly!"

Says Charlie, the elephant: "Had I stayed in the old country I would have been nothing but an ordinary laborer: here in America I am an actor of no small fame. I have a fine memory and so this movie game is all very simple—one rehearsal is enough for me"

The extras speak: "All morning we were starved; then they let us loose in a grocery store and we made for the pieces of raw meat that we smelled. All the while the camera man was grinding away. Foolish, don't you think?"



Ethel says: "Once I lived in a Zoo; but that easy life kills ambition, so I got out before it was too late. I went into the movies and have starred in 'The Lion's Claws,' 'Lost in the Jungle,' and 'The Lure of the Circus'"



© International Film Service Co.

He looks like Santa Claus, and he is one; all through the year he makes Christmas toys; thus he is able to earn his living

Toy-Makers in Santa's Work-Shop

ALL through the year, when you have forgotten all about Santa Claus, eighty very old men and women are patiently making Christmas toys. They had thought they were too old to be of any use in the world until the New York Association for Improving the Condition of the Poor started a small toy factory for them. The finished toys are sold in a store and the profits go to the workers. Thus they are able to earn a living.

When the factory was started there were only about ten workers, but now their number has increased to eighty, and they have moved from their small work-room to a much larger one.

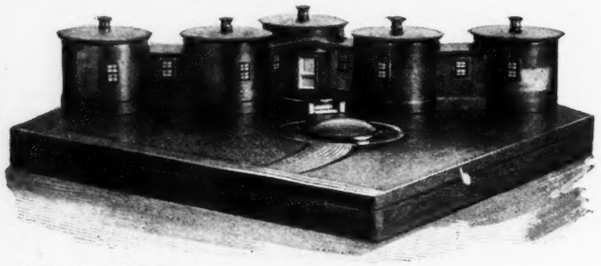
Using Compressed Air to Mix Paint

READERS of the POPULAR SCIENCE MONTHLY have been made familiar with "paint-guns," which eliminate laborious brush-work on rough jobs by using compressed air to spray the paint on the surface to be coated. Now an ingenious workman has called in compressed air to save the back-breaking labor of stirring paint. In his shop, as in many others, a large supply of paint is kept always on hand. It is necessary to stir the paint from time to time to keep it properly mixed and ready for service.

There happened to be a high-pressure air supply handy to the paint-room, so the workman rigged up a double wooden paddle for each paint-tub with the paddle shaft projecting above the top and held in place by cross-pieces. When the paint needs stirring a pneumatic reaming tool is slipped over the end of the paddle shaft, the paddle is whirled rapidly around, and the paint is thoroughly mixed in a surprisingly short time. It is necessary only to shift the reaming tool from tub to tub to stir the whole lot.

Should Home Look Like This?

"SQUARE houses belong to the devil." This startling statement was made by Mr. C. N. Wisner, a New Orleans inventor—not in a campaign against the landlords of apartment-houses, but in behalf of the new round house Mr. Wisner has invented. A model of one of these houses is shown below. At first glance it looks like five pots with their lids clamped down, but you soon notice the windows and the halls that join the rooms together, each seeming pot representing a room. You can start with one, and add one by one as you wish. They are made of concrete cast in steel molds.



© Keystone View Co.

These are not five pots linked together, but five rooms, hallways, and closets—a model of what the inventor calls the perfect house

How Much Wind Can She Stand?

WHIR! Whiz! The wind shot through the wind-tunnel, and the small airplane quivered. Just below her, two men glued their eyes to a strange-looking instrument known as an aerodynamic balance, and alongside of her another man looked in at her through a glass window. They were testing her to see how she stood up under the force of wind of varying velocity. A fourth man regulated this speed.

The airplane is a tiny model, one twenty-fourth as large as a regular airplane. The wind-tunnel runs the whole length of the room and is four feet square.

The balance is the only one of its kind in the country, and is so accurate that it can measure to within one ten thousandth of a pound. By adjusting a series of weights the men can determine the effect of the wind on the airplane. The whole outfit is located in the Massachusetts Institute of Technology, and it was used by the army and navy throughout the war.

Photographs © Wide World Photos

The man on the landing is looking through a glass window at a small model airplane fastened inside of a wind-tunnel; the man to the left is regulating the speed of the wind that he is sending through the tunnel; and the two men directly under the spot where the airplane is fastened are reading an aerodynamic balance that tells the effect of the wind on the airplane. They can be seen more plainly in the picture at the right.

One of the Great Unknowns

This Edison of the rifle-barrel won't quit work till he quits life

By Herbert Asbury

BOARD a tunnel train under the Hudson river, and get off at the Exchange Place station in Jersey City. Then walk down Hudson street, perhaps the dirtiest and noisiest of all the dirty and noisy streets of Jersey City, until you reach Morris street, in the midst of a multitude of machine-shops and foundries whose clangor and clamor is never stilled, and within sight and sound of the bellowing steamships that line the Jersey City docks and piers. Walk down Morris street to No. 18, a dingy and dilapidated old structure, and climb the stairs to the fifth floor. And there, while your ear-drums are assaulted by the screeching whine of a planing-mill on the same floor, you'll see at the head of the stairs a sign:

POPE'S BELL

Bell out of Order. Knock on the Glass

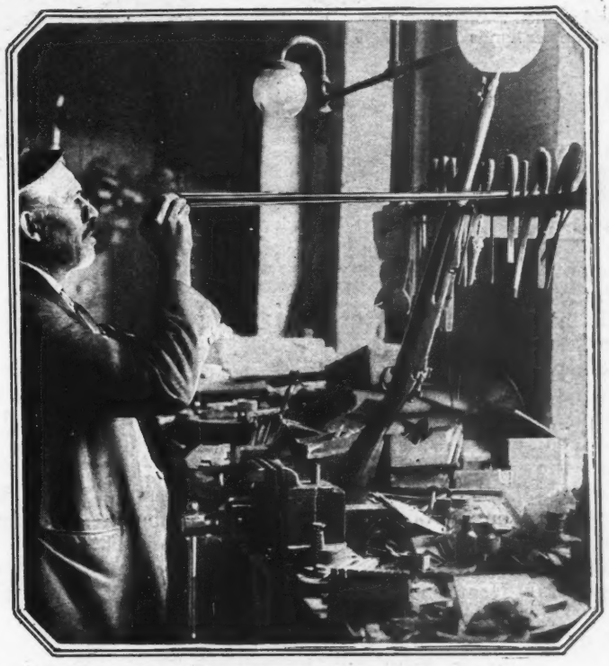
You knock and knock, and then you knock again, trying vainly to compete with the planing-mill and the noises of machinery that come filtering up the stairs. But finally the planing-mill subsides for an instant, you pound on the door with all your might, and suddenly it is opened by an old man with very gray hair, a homemade cigarette drooping from his lips, a little black cap on the back of his head, and a twinkle in his bright gray eyes.

He is the Edison of the rifle-barrel. His name is Harry M. Pope, and he is hard to find.

Truly he is a prophet without honor in his own country. He is known wherever rifle experts gather and wherever fine rifles and fine ammunition are manufactured; but in his own home town the rank and file of the population—and the big business men, too—never heard of him. He has lived in New Jersey for almost fifteen years, and in all of that time his work-shop has been in 18 Morris street—but his name does not appear in the city directories, nor in the telephone directory, and the Chamber of Commerce of Jersey City has no record of him. The writer succeeded in finding him only because an ancient gunsmith on the outskirts of the city happened to remember his address.

The shop in which Mr. Pope manufactures fine rifle-barrels and does the delicate work of adjustment seems to an outsider to be cluttered with tools in hopeless confusion. But there really isn't any confusion at all; he just hasn't room for all his tools. Every nook and corner of the place is jammed with lathes and punches and dies and tools of all sorts—with the exception of a small space in a corner.

That space holds a rather dilapidated couch, with a faded blue necktie thrown carelessly upon it, and a pair of heavy army shoes peeping from beneath it. This is where Mr. Pope does most of his sleeping—when it occurs to him to sleep. He doesn't sleep a great deal; he thinks, with Edison, that it is a waste of time.



The shop may seem to you to be a hopeless clutter of confusion. It is not. The fact is, Mr. Pope hasn't room for all the lathes and punches and dies and other tools necessary in his business of making rifle-barrels

He eats regularly if he happens to think of it, otherwise only when he becomes so hungry that the matter of food intrudes itself. He has a home, of course, and a family,—two of his boys were in the American Army during the war,—but he is so much in love with his work that he sleeps in his shop some four or five nights a week.

"But I'm getting a little tired now," he said, "what with all this noise and so much work. I'd like to be in the country for a while."

"Are you thinking of retiring?"

"Retire!" exclaimed the wizard of the barrels indignantly. "I'll retire when I'm dead! What I meant was that I'd like to have my shop in the country, where I could get a bit of fresh air."

The postmarks on the great mass of letters piled on Mr. Pope's work-bench demonstrate that, if without honor in his own country, he certainly has great honor in Canada and in California and Maine and all of the other states of the Union.

Mr. Pope has known and loved rifles all his life.

"I began shooting when I was a kid," he said, "and I've been shooting ever since. I had a hard time finding a gun that would shoot like I wanted it to shoot, and like I knew it ought to shoot, so I went to work and made one. I liked the work so much that I kept at it."

Manufacturing rifle-barrels is about everything that Mr. Pope does. Repair work is distasteful to him, and repair work on barrels is the only thing of that sort that he will do at all. His delight is to take a perfect action direct from the factory and fit that action with a barrel of his own making—and the combination is a gun that wins championship matches. He has made many rifles of that sort; for, after all, it is the barrel that determines whether a weapon is a rifle or merely a piece of junk in the form of a rifle, and some of the guns that he has made have been considered by experts the finest in the world, and all of them in the hands of marksmen have brought home record scores and medals galore. Many of these prizes and medals the visitor will find hung on nails in a corner of Mr. Pope's work-shop, because he can shoot about as well as he can make rifle-barrels, and has won many big rifle tournaments.

Mr. Pope is a native of New Hampshire, and possesses a little more than his rightful share of New England reticence. Like all true artists, he is modest. However, it was learned, by dint of persistent questioning, that he has been making rifle-barrels for more than thirty years. He has had shops in various New England towns, and once went to the Pacific coast. But he lost everything he had in the San Francisco earthquake, and then returned to the East and settled in Jersey City.

Even if he achieves that dream of a place in the country, he probably won't see very much of it, because the most striking impression that one gets of Mr. Pope is that he will continue to work with his rifle-barrels for eighteen hours a day as long as he lives.

She saw the burglar coming, and pushed two buttons concealed on her bed; then she threw up her hands as requested

Announcing Mr. Burglar

"BULLET Johnson," burglar, ransacked the ground floor of a house in Philadelphia and then invaded the owner's bedroom. "Keep your hands in sight and your mouth shut," said he, and his victim promptly obeyed. A few minutes later "Bullet" left the house, and several policemen ran out to meet him. He is now serving a five-year sentence in prison.

How did the police find him out? In the side of his victim's bed two push-buttons were literally embedded. When the woman in bed heard the door creak and saw it move as the burglar entered, she pressed both buttons, one of them once, the other twice. A bell rang in the house on each side of her, and the neighbors woke up and called the police.

Wilfred B. Henderson originated the idea.

His house was one of eighteen on his block, and there had already been six burglaries near by. He suggested that electric bells with push-buttons be placed on one of the beds in each house, and that they be wired together, so that each house might ring up the houses on each side should a burglar appear. One ring means the house on the left and two the house on the right.

Can You Name the Seven Seas?

OMAR KHAYYAM and Kipling both talk about the Seven Seas. What are these Seven Seas?

They are really the five oceans—the Arctic, the Antarctic, the Atlantic, the Pacific, and the Indian oceans. And the number seven is derived by dividing the Atlantic and Pacific oceans into halves, and calling these halves the North and South Pacific and Atlantic oceans.

The reason for this is supposed to be that the number seven symbolizes completeness or perfection. As early as the beginning of Christianity, the rabbis affirmed that "God made the Seven Seas."

Shop-Lifting Up to Date

"LET me see that necklace in the case over there," says the lady to the salesman. He goes after the necklace and brings it back; she decides not to take it, and goes out.

Shortly after she has gone various articles are found to be missing. They went with the lady, who was a shop-lifter. The method of working was to get the salesman out of the way by a subterfuge. While he was gone she "accidentally" knocked down sundry small articles, which she kicked close to the counter. Shortly afterward, under cover of tying her shoe-lace, she transferred them to a couple of strong elastic garters that she wore around her legs. After her real business had been accomplished the proposed purchase, of course, no longer interested her.

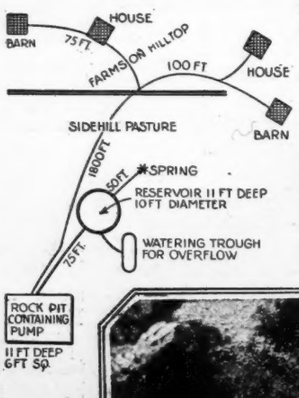
A shop-lifting device that emanates from England; London stores suffered accordingly

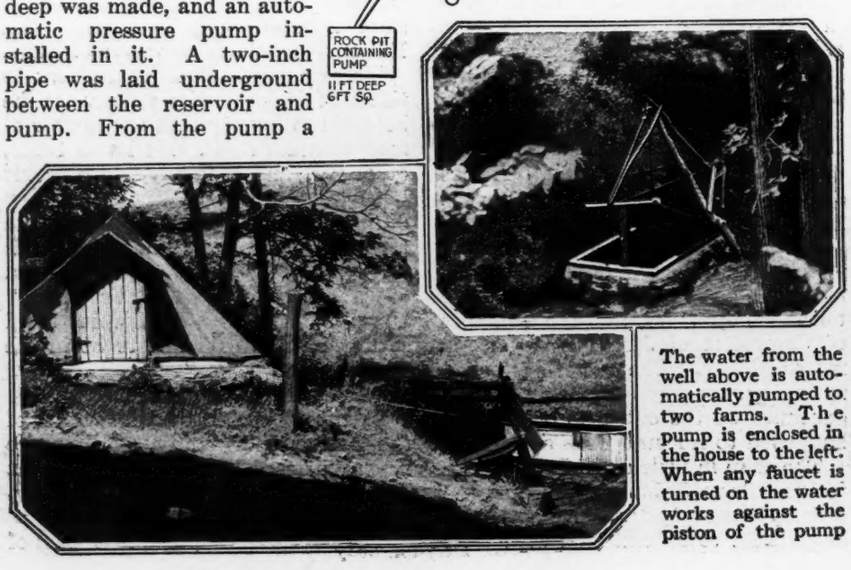
Harnessing a Spring to Pump Itself

BY harnessing a spring so that it pumps itself, two farmers who live on opposite sides of the road on an Iowa hilltop near the Mississippi river have running water in their homes and barns. Their farms lie on top of the hill. The long timbered slope of the hill is owned by one of the farmers and used as a pasture. Near the top of the hill a spring bubbles out of the limestone.

The spring was cemented in to keep out impurities. Fifty feet below, a cement reservoir eleven feet deep and ten feet in diameter was built in the ground and the water from the spring piped to it. Seventy-five feet down the ravine from the reservoir a square rock-pit eleven feet deep was made, and an automatic pressure pump installed in it. A two-inch pipe was laid underground between the reservoir and pump. From the pump a smaller pipe was run to the top of the hill, a distance of eighteen hundred feet and a lift of four hundred feet. At the top it branched into two p pes.

The system works automatically. Open any one of the faucets on the two farms and the pump begins to work. The water, as it drops through the pipe from the reservoir to the automatic pressure pump, works against the piston with a pressure of forty-five pounds to the inch, driving the piston with a force that sends the water uphill. When the faucets are closed, the back pressure of water holds the piston so that it cannot work.





The water from the well above is automatically pumped to two farms. The pump is enclosed in the house to the left. When any faucet is turned on the water works against the piston of the pump

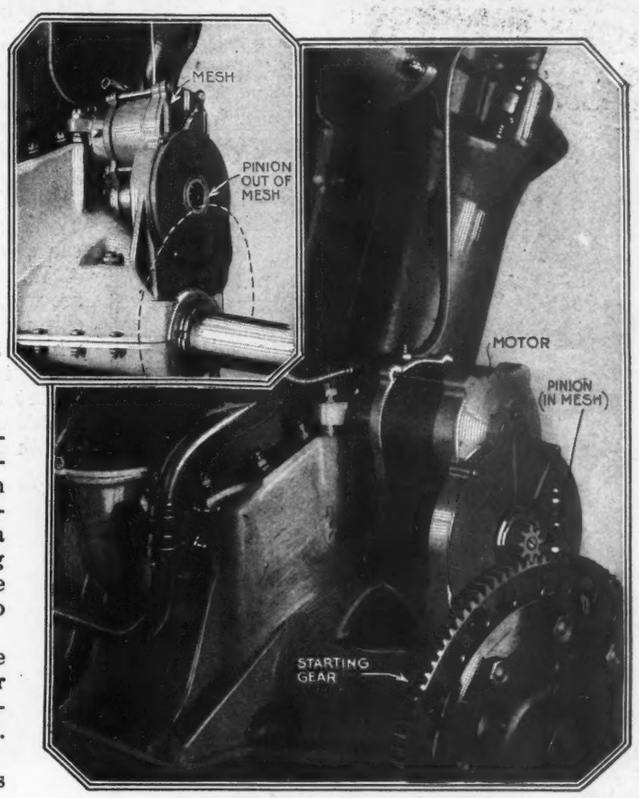
Self-Starters for Airplanes Introduced by the N. C. Craft

EVERYONE who has read the magazine sections of the Sunday newspapers during the past year knows that the engines of airplanes are started by man power. You have probably seen pictures showing a team of three or four men, hands linked, starting the propeller, the outside men pulling the man who actually turned the propeller out of the suction of the revolving blade at the critical moment.

With millions of automobiles equipped with self-starters, the question has often been raised as to why airplanes were not fitted with a similar device. One thing that prevented this was the additional weight necessary to install such equipment.

All these problems have been overcome by a starter manufacturer, the first apparatus being fitted on the N. C. boats.

The new apparatus consists of a small twelve-volt motor operated by a storage battery weighing twenty-six pounds.



Now comes the self-starter for airplanes, a feature long needed by pilots. No more danger of injury to the mechanic if it is attached to your airplane

The current revolves the armature shaft of the motor. A small pinion on the end of the armature shaft drives another small eight-toothed gear, which meshes with a larger gear attached to the propeller-shaft, so that the engine-shaft and propeller are automatically started. The starter turns the engine at from forty to fifty revolutions a minute, and the storage battery has sufficient capacity to start the engine one hundred and fifty times.

The pinion on the drive-shaft does not mesh with the shaft gear until the starter button is pushed, when the pinion automatically slides along the screwed end of the shaft until it drives the shaft gear to the propeller. As soon as this begins to revolve faster than the driving pinion, it is thrown out of mesh and the battery current conserved for the next starting operation. This apparatus opens up great possibilities for the future.

Whale Ho!—There She Blows!

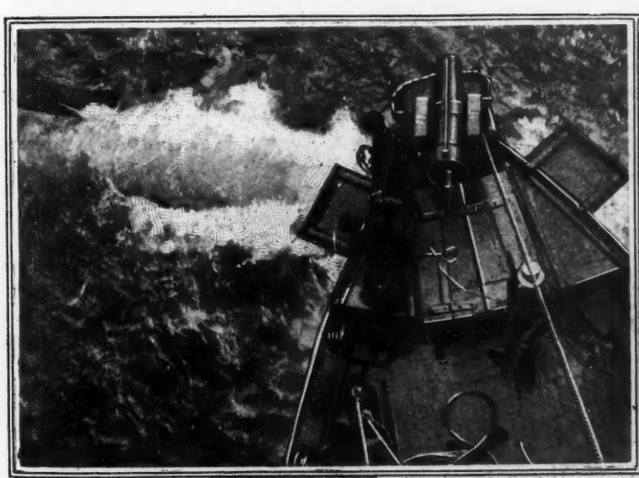
WHALING has been followed for hundreds of years. In the old days of hand harpoons only the sperm, bowhead, and right whales were hunted; but today, with modern equipment, every kind of whale, from the giant blue whale or sulphur bottom to the killer whale, is sought.

The whale yields many products of commercial value—whalebone, oil, fertilizer, and glue. In Japan whale meat has become an important item on the menu of the poorer classes, and it is canned and shipped to all parts of the empire.

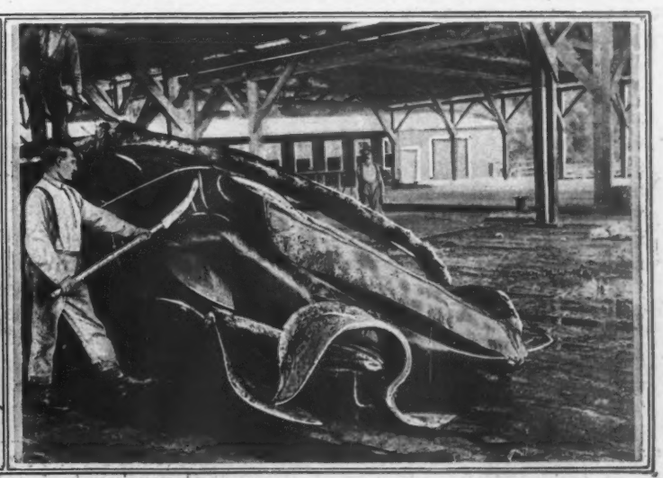
Whale-hunting is a dangerous pursuit, and whalers are a rough, hardy lot. They must withstand all kinds of weather in their boats, which are small and round-bottomed to facilitate manipulation and speed.

It often happens that a whale, harpooned from the steamer, is not mortally hurt. It is too wild to get in another shot, so a small boat is put out and the game lanced through the heart or lungs with a slender spear. Often the whale will smash the small boat in its death flounderings, if the rowers are not agile enough to dodge its great flukes, so only the most skilful men are allowed to finish a wounded whale.

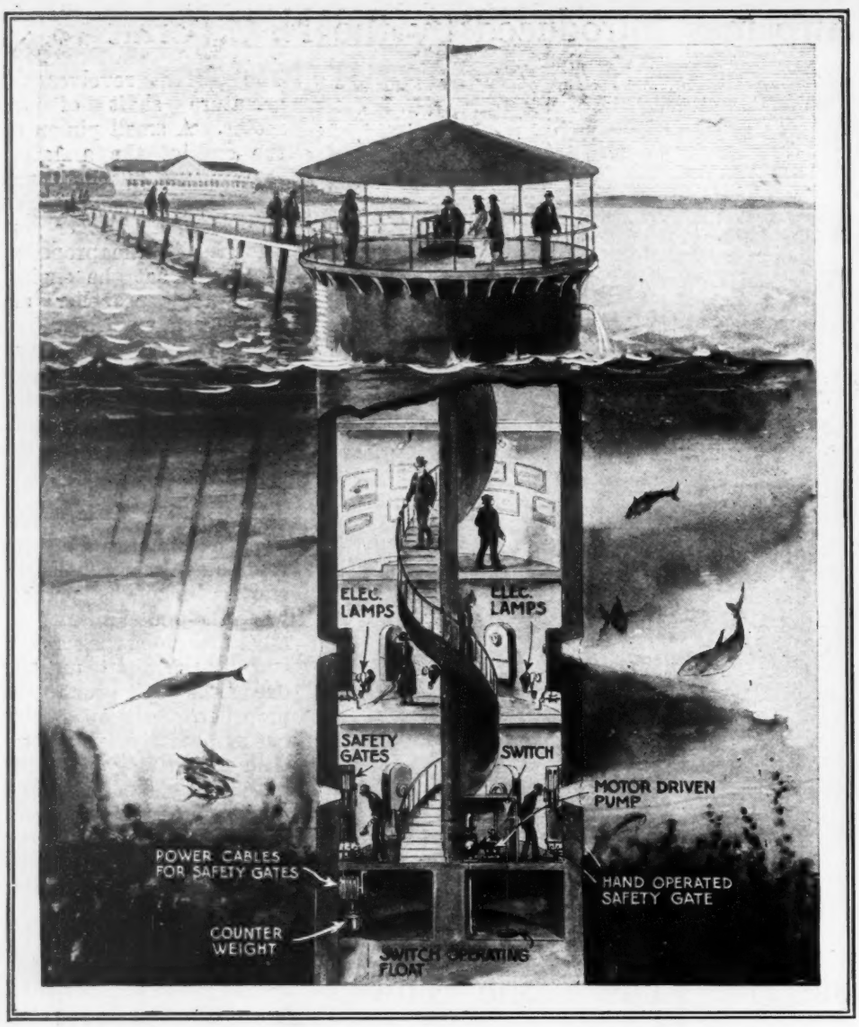
Whales migrate with the seasons. In the early winter they go south, returning north again in the fall.



The harpoon exploded in the lungs of the whale and it died almost without a struggle and sank. The winch will raise the forty-ton body



Cutting up the head of a dead whale after it has been drawn up on the slip at the shore station. The men work with long-handled knives



For a small consideration, even the poor man may have the pleasure of watching high-priced fish and aristocratic oysters in their natural habitat

Visiting the Fish Without Getting Wet

HOW to observe fish and other sea creatures in their natural environment, without undergoing the dangers and inconveniences of descending in a diving-bell or a diving-suit, has been solved by Edward D. Stodder, of New Rochelle, N. Y.

He proposes to build a pier far enough out over the water so that the wave motion does not disturb the sand on the sea-bottom. At the sea-end of the pier one or more cylindrical structures of steel, cement, or masonry are to be placed. These caissons, which will rest on a firm foundation, are to be high enough to be easily accessible from the platform of the pier through a door in the side of the tower-like caisson.

Around a pillar in the center of the caisson a spiral stairway leads downward below the level of the ocean. Three rows of openings are provided in the submerged part. These openings are funnel-shaped, with the narrow part inside of the caisson and closed by heavy lenses of glass strong enough to resist the pressure of the water. The uppermost and the lowest rows of openings are for observation purposes, the middle row for the purpose of illuminating the parts of the water visible from the observation windows.

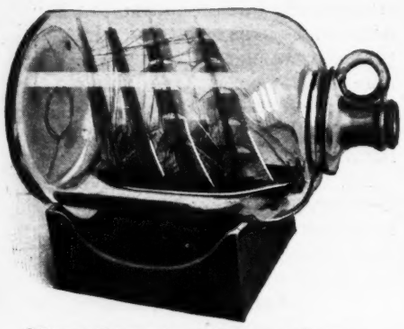
The inventor has provided means for closing the openings in case one or more of the glass lenses should break. The water, rushing through such an opening, automatically starts a mechanism which slides water-tight shutters in front of every one of the openings, and at the same time sets in motion a pump for removing the water which has come in through the broken glass. He has also provided for the closing of all openings by hand power, should the closing mechanism fail to work.

Something to Put in Your Empty Bottle

GOT any empty bottles? Bottle ships in them. Bottled ships are really quite simple. The masts and other parts that project above the hull may be controlled by strings. The hull itself must be made small enough to slip through the neck of the bottle. Then you mount the masts and attach the cords.

When you are sure that all the cords are working properly, slip the flattened ship through the mouth of the bottle, which should contain some moist putty to serve as a bed for the boat to rest on.

Pull up the strings, glue them to the mouth of the bottle, and then cork it.



Mount the masts so they may be managed by cords; when down, slip the whole through the neck of the bottle

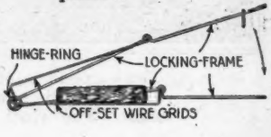
Overcoming Obstacles to Perfect Broiled Hamburger

IF Arthur E. Cowan, of Gloucester, Mass., had never eaten broiled chopped meat, one less patent would have crossed the threshold of the Patent Office. It is a broiler so made that, should it stick to the wires, it will prevent broiled hamburger from crumbling to pieces when you try to lift it.

It is made in two sections, held together at one end by rings; the other ends are free to rotate. The wires are bent at one end. You place your hamburger on one section and close the other down over it.

Should the steak stick to the lower one while cooking, swing the upper one all the way round, and the bent wires will gently dislodge the meat, which then slides on to the platter.

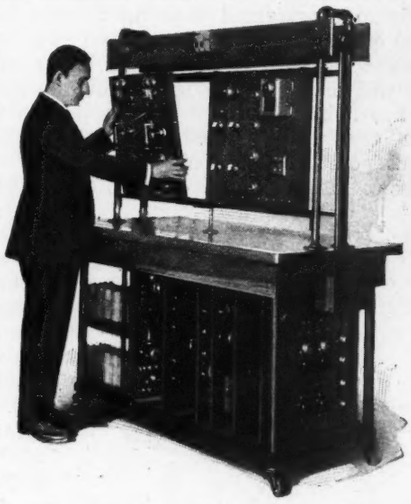
Should the meat stick to the lower section, the upper is swung around beneath it, and its bent wires dislodge the meat



An Electrical Cabinet Designed for the Class-Room

THIS new electric cabinet, containing everything necessary for the study of electricity, looks like a kitchen cabinet. In the first place, there are two shelves that hold nothing but batteries; these batteries are used to supply the current for experiments. Since the voltage is low, danger of shocks and accidents is eliminated.

Then there are several boards that slide into grooves in the cabinet. These are fitted up with various electrical instruments, such as bells, telephones, meters, and push-buttons. The boards may be taken out of their racks and hung up in front of the class, and the pupils can practise on them.



The electric cabinet for teaching electricity contains many boards on which there are several electrical instruments; the pupils wire them up

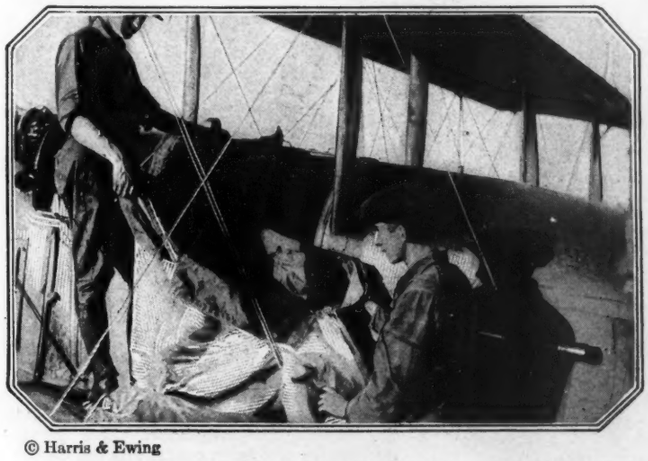
Fireproofing the Air Mail

YOU want to rush an important document to Washington by air mail, but you are afraid to. Suppose the airplane should catch fire? Your document would be burned, you think.

But you are wrong. Air mail is wrapped in an asbestos cloth container that is fastened to the airplane by thin steel strips and screws. Ten yards of asbestos cloth and ten yards of khaki cloth are used in the container. The asbestos cloth weighs two and one quarter pounds to a square yard.

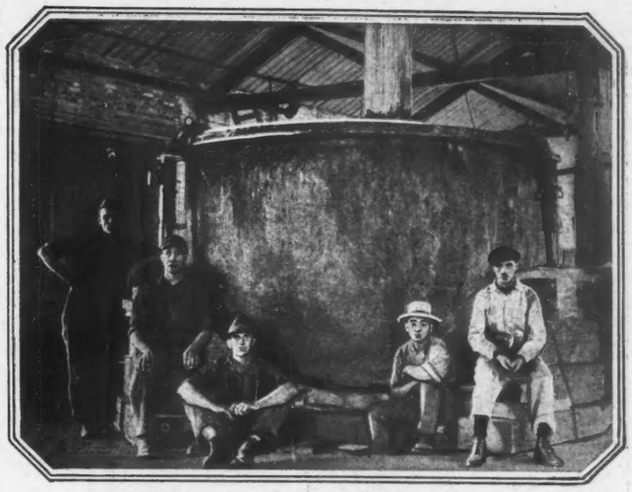
The Post Office Department tested one of these new fireproof bags at College Park, Md. A sack of dummy mail was enclosed in the bag, and the bag was soaked in gasoline. It was then set on fire and allowed to blaze for twenty minutes.

When the blaze was put out, at the end of that time, it was found that nearly all the letters were intact—the few on the outside being slightly charred.



© Harris & Ewing

Air mail is now enclosed in bags made of asbestos cloth; even should the airplane catch fire, the mail will be safe



A big caldron raised from the heating well by means of jacks placed under the lifting lugs attached to the rim

Lifting a Heavy Caldron Without the Help of a Crane

IN the manufacture of caustic—which, in the language of chemistry, may be either sodium or potassium hydroxide—large caldrons of cast iron are used. Many of these caldrons have a diameter of ten feet, a depth of seven feet, and weigh about fifteen tons. Each one of these enormous kettles is placed in a well of fireproof brick and its bottom rests on ball-bearings supported by a pedestal of concrete, centrally placed in the bottom of the well. In the sides of the well are openings communicating with the furnace. The kettle is rotated to prevent uneven heating.

Occasionally it becomes necessary to lift the caldron out of the well. A crane sufficiently strong would cost a great deal. Frank G. Wheeler, of Appleton, Wis., uses detachable lifting lugs of C shape, which fit around the rim of the caldron and have a bracket at one end which engages the under side of the raised flange of the kettle. After three or more of these lugs have been clamped to the rim of the caldron, jacks are placed under them and the heavy kettle is lifted from its support and out of the heating well.

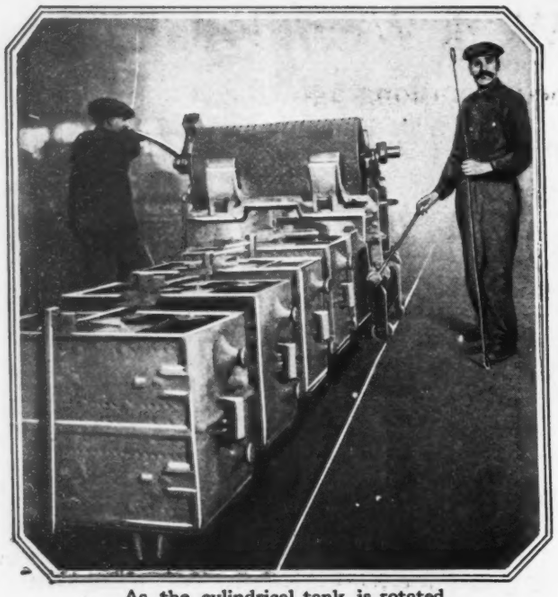
This mechanical watch-winder saves many sore fingers in a large repair shop

A Machine Even for Winding Watches

WHEN you wind your watch up at night, you do not feel that you have performed a very strenuous operation; neither have you. But multiply the operation by twenty, a hundred, two hundred, and you begin to have visions of aching fingers and sore thumbs. This is exactly the way the watch repairer finds it.

To save both time and fingers, an ingenious watchmaker invented the winder, a photograph of which is reproduced above. It is merely a metal clip to hold the watch and a clutch that engages the winding key. Insert the watch in the clip, hold it tightly, turn the handle a few times, and the watch is wound.

Many a repairer has several hundred watches on his racks at a time, and some such device as this is a great convenience and time-saver.



As the cylindrical tank is rotated, molten iron pours from nozzles into molds; two men handle it easily

Making It Easy to Handle Molten Metal

LADLING molten iron by bucket requires plenty of help and much care. A Cleveland foundryman has invented an efficient ladling-machine that can be worked by two men.

A cylindrical tank mounted on wheels that run in tracks is filled with molten iron. One man moves the tank until it is directly over troughs that lead to the molds. Then the other man turns a handle and the tank revolves. Two nozzles discharge the iron into the troughs every time the cylinder is rotated. The tank is then rolled onto the next set.

The tank is made of heavy boiler-plate lined with fire-brick.

These five pieces of type, bearing strange Oriental characters, were used in Korea in the year 1403

Five Centuries Old Type

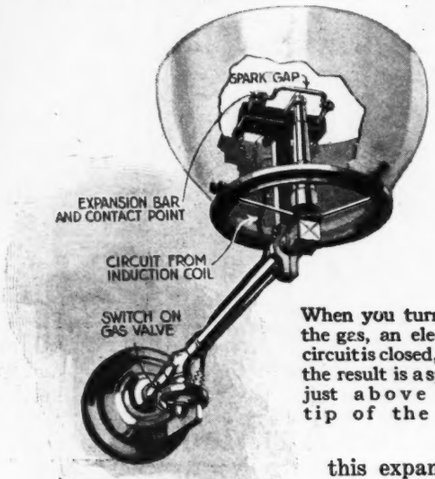
BACK in the beginning of the fifteenth century, the Korean printer sat cross-legged in front of a "form" and "pulled proofs." And even in that far-off day he used metal type not so very different from the type used now. The strange Oriental characters stood out from the upper surface of each piece of type, and the lower surface was curved so that it would cling firmly to the bed of beeswax into which it was sunk. The printer inked the type, laid the paper on it, and gently brushed the paper with a piece of felt. Thus he pulled proofs at the rate of fifteen hundred a day.

Fifty pieces of this type are now in the American Museum of Natural History, New York, and fifty more are in a museum in England.

Turn on the Gas Like Electricity

YOU light a match, turn on the gas—and the match goes out. Then you turn off the gas, look for another match, and start all over again. Ah, but there is an automatic gas-lighter, invented by Edward Obermeyer of Nessen City, Mich.

It is so constructed that an electric spark jumps across the tip of the gas-jet every time the gas is turned on. Furthermore, if the gas should be blown out accidentally the spark will reappear and ignite the escaping gas. The gas-cock has a bar within it that is part of an electric circuit. When the valve is closed the bar does not touch a contact point near it and the circuit is broken. But when the cock is turned and the valve opened the two contact points touch each other and the circuit closes. A current is induced into a second circuit, whose contact points are spaced a short distance apart directly above the tip of the jet. This current is strong enough to cause a spark to jump across the gap and light the gas.

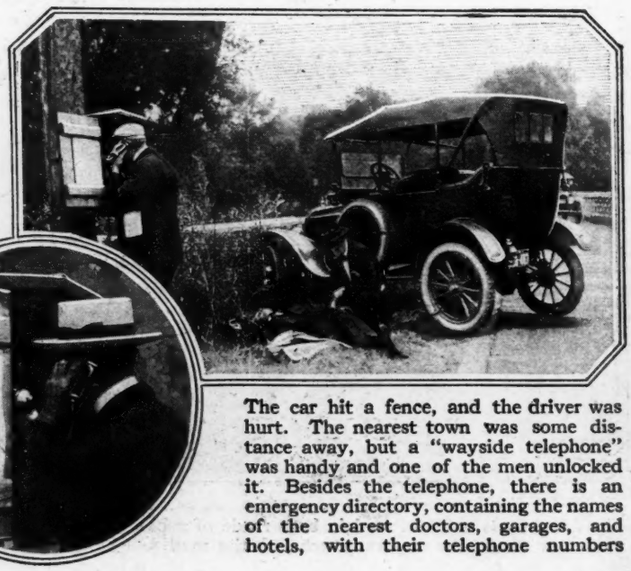


When you turn on the gas, an electric circuit is closed, and the result is a spark just above the tip of the jet

Once the gas is lit, the heat from the flame will expand the arm that furnishes one of the contact points of the spark, and this expansion breaks the primary circuit and does away with the spark.

In Case of Emergency Use the Wayside Telephone

YOU start to skid, lose control of your car, and crash head-on into another car! You are miles from the nearest town—what's to be done? In a case like this a "wayside telephone" is a godsend. All you need is a key to the telephone box. These boxes are painted red and white and are located a mile apart on the road along the Mohawk river in New York State. In case of accident of any kind, you walk to the nearest one, and open it. Inside you will find a telephone and a list of the nearest doctors, garages, hospitals, and hotels, with their telephone numbers.



The car hit a fence, and the driver was hurt. The nearest town was some distance away, but a "wayside telephone" was handy and one of the men unlocked it. Besides the telephone, there is an emergency directory, containing the names of the nearest doctors, garages, and hotels, with their telephone numbers

Why Small Models Won't Work When Enlarged

The Patent Office abandoned them long ago

By C. A. Briggs

MANY years ago the Patent Office abandoned the practice of requiring working models when issuing patents. This was done in the face of increasing complexities in the devices presented for patenting. Now patents are issued on the basis of drawings and descriptions, except in special cases.

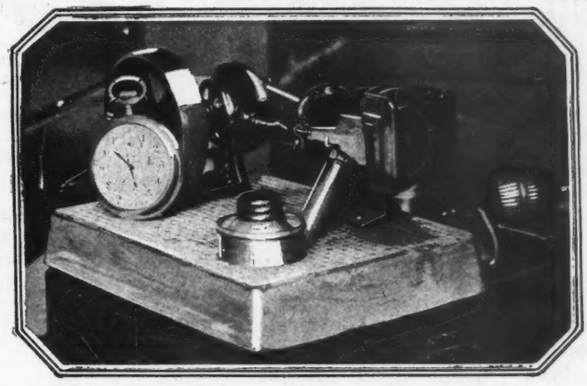
It was found that models were often more misleading than instructive. The full-sized model may prove impractical even when the small one seems to work perfectly; and the reverse may be true—a large design may give results to an extent that was not indicated at all in the small model.

Probably no better device for illustrating the achievements and perfection of modern design could be found than the typewriter of the present day; yet the same arrangement when made on a large scale will serve to illustrate just what a design should not be. A fourteen-ton typewriter was built for the San Francisco Exposition by a typewriter company. When this large typewriter was operated, the arm carrying the type on the end moved ponderously up and struck with a *pung*. It then fell back with a *clank*, and bounced two or three times before coming to rest. These arms were so heavy that a special engine had to be installed in the foundation below the typewriter to operate the parts.

The spring that caused the carriage to move was a relatively weak one. If this spring had been made to scale, its use would soon have wrecked the machine. On the ordinary sized typewriter of this design a speed of one hundred and seventy words a minute has been obtained by the best experts. The huge model was capable of about thirty letters a minute.

There are certain relations between the strength, weight, inertia, size, time of action, and deflection that dominate design; and good design is always consistent in this respect.

Some time ago the writer was shown a toy engine. The parts comprised a flywheel, a crank, a piston, a cylinder with an opening at one side near the closed end, and a valve consisting of a piece of thin sheet-iron that could be moved back and forth across the opening by means of a rod engaging a cam mounted on the axis of the flywheel. Just in front of the valve opening there was a tin lamp with a wick for burning alcohol.



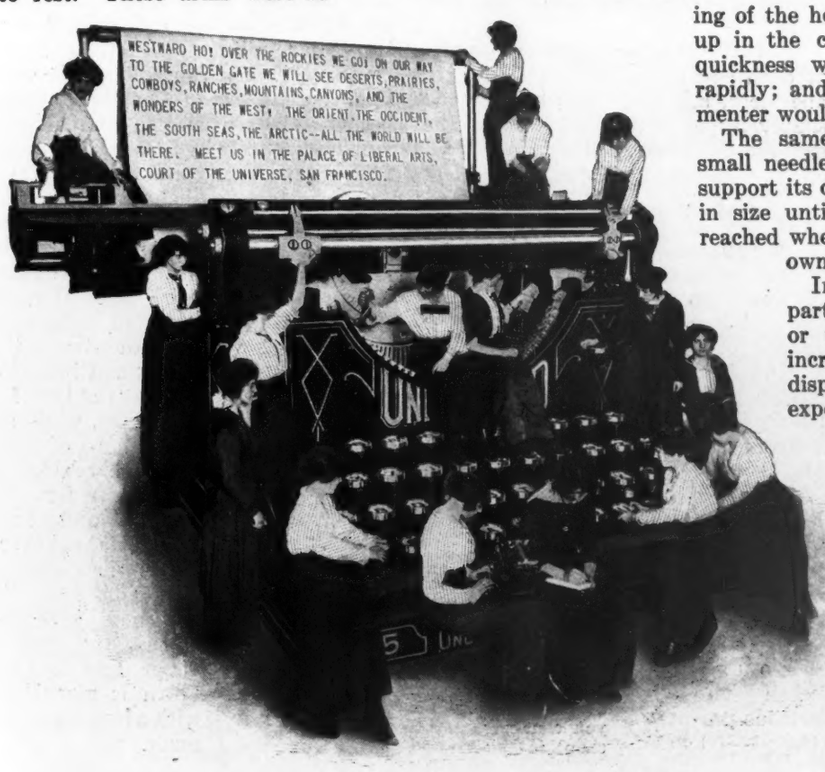
This tiny engine is a speed demon; the piston is shot backward and forward by the rapid heating and cooling of the cylinder—the heat being produced by an alcohol flame and the cooling by the shutting of an automatic valve. But would this hold good for a large engine? That is a question

When the engine was started the piston moved away from the opening and thus sucked in the hot alcohol flame. Just before the end of the stroke was reached the valve would close the opening, and the cooling of the hot gases would then create a partial vacuum. The result was that the piston was jerked back. The power and speed of this little engine was surprising. When going well it would simply roar. The behavior of the engine was so striking that it occurred to almost everybody, on seeing it run, that it would be desirable to make a large engine on the same principle.

However, one thing on which the action of the engine depended was the very rapid cooling of the hot vapors and gases when they were shut up in the cylinder. Now, as the size increases, the quickness with which the gas cools falls off very rapidly; and if a large design were made the experimenter would find his attempt a failure.

The same thing applies to electrical devices. A small needle can easily be magnetized so that it will support its own weight. When the needle is increased in size until it becomes a bar, the point is soon reached where the bar will not be able to support its own weight.

In electrical machinery the heating of the parts is often the limiting factor in the capacity or use of a device. The heating tends to increase with the volume, and the ability to dispose of this heat increases as the surface is exposed. The volume increases as the cube of the dimensions, and the surface as the square of the dimensions. It is therefore necessary in the larger sizes of machines to alter the design to provide, among other things, the necessary arrangement for getting rid of the heat.


WESTWARD HO! OVER THE ROCKIES WE GO! ON OUR WAY
TO THE GOLDEN GATE WE WILL SEE DESERTS, PRAIRIES,
COWBOYS, RANCHES, MOUNTAINS, CANYONS, AND THE
WONDERS OF THE WEST, THE ORIENT, THE OCCIDENT,
THE SOUTH SEAS, THE ARCTIC--ALL THE WORLD WILL BE
THERE. MEET US IN THE PALACE OF LIBERAL ARTS,
COURT OF THE UNIVERSE, SAN FRANCISCO.

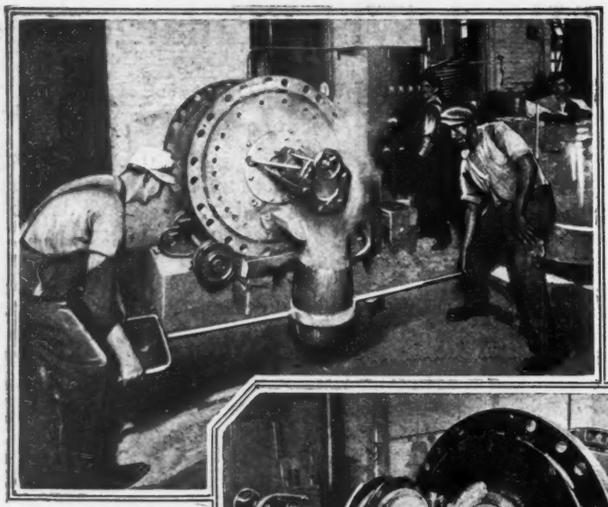
This fourteen-ton typewriter is an exact enlargement of one of the present well known machines. Its operation is difficult and slow. Small models often fail to work after they have been enlarged

A Grip for the Rivet

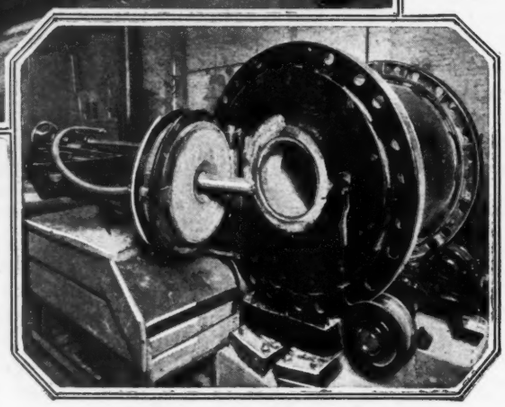
RAT-TAT-TAT! The sound of riveting drowns everything else; and the riveter must listen to it all day long while he tightly grasps the vibrating hammer. A hard life, to be sure.

But a grip has been invented that will make his work much easier. It fits over the business end of the hammer and provides a sure grip. The riveter simply grasps a projecting handle in order to guide the hammer to the work.

The grip is made of steel and can be used on chipping or calking hammers. It adapts itself to either right- or left-hand riveting, and is particularly helpful for overhead riveting.



The molten brass is being poured from the electric furnace; the man at the switchboard controls the flow



This is an electric furnace; the electrode that heats the metals is seen protruding from inside of the door

A grip has been invented that fits over the muzzle end of a riveting hammer and has a projecting handle that the riveter grasps; his work is thus made much easier

It adapts itself to either right- or left-hand riveting and is particularly adaptable to overhead work

Making Brass in an Electric Furnace

A NEW electric furnace for melting copper and zinc to make brass has recently appeared. Hitherto it has been possible to melt these metals and alloys only in crucibles.

The electric furnace is rotated by rollers and moves in two cylindrical tracks. The rollers are driven by a motor at the proper speed to make the furnace rotate at the rate of two revolutions a minute. The electrodes for melting the metal are heated by a current that comes through short pieces of flexible cable that connect with the track; and the current is supplied to the track by means of shoes which press against it.

On small furnaces electrodes are operated by hand, but on the larger furnaces automatic electrode control is used. In the small furnaces the door is in one end only, but in the larger furnaces both ends are provided with doors. In the lower of the two pictures above you can see the latch that holds the door shut when the furnace is charged, and also the electrode projecting through the door. The contact shoes are shown pressing against the track.

The cable that supplies the power to the furnace comes from conduits in the floor. The operator regulates the flow of the current by means of a hand-wheel. The upper picture shows the metal being poured from the furnace. The operator at the switchboard is controlling the furnace by means of push-buttons. The two men in front are holding the bucket.

Probably the most important of all factors in reliable and efficient furnace operation is the furnace lining. Especially is this true with the melting of non-ferrous metals, where a lining with many joints will have a decided tendency to absorb metal. In order to overcome this difficulty the lining should have as few joints as possible.

In this furnace the electrode supports at each end of the shell are made in one piece, and they may be removed simply by unbolting them from the end plates. The shell can be lifted off the rollers by a suitable hoist or crane, just as if it were a barrel, and turned on end. Thus the end plate of the furnace can be unbolted and removed from the shell.

The door of the furnace is made of one solid piece of brick, with a hole in the center through which the electrode projects.

A New Reason for a Clean Face

DID you ever have to start on business to a distant city on a few minutes' notice, with just time to buy your railroad ticket, a tooth-brush, and a clean collar? Perhaps that is what was in Charles E. Gronbeck's mind when he invented a vest-pocket edition of the safety razor.

The new razor consists simply of a light frame to take the blade. The lower edge of the frame is provided with the familiar serrated edge to smooth down the cheek and bring up the bristles for slaughter, while an extension of the frame provides a firm grip for the thumb and first finger of the shaver. The inventor points out that his device is self-contained, and that a closer grip is had than is possible with a long-handled razor.

© Press Illustrating Service

So small is this safety razor that you can carry your own barber-shop in your vest pocket

Around the World in a Minute

YOU can cross the Atlantic ocean in three seconds! Leap over a volcano in one bound! Race from the North to the South Pole in half a minute! That is, if you visit the miniature Earth built in Boy Land, Santa Barbara, Cal. The Earth is laid out flat, map fashion, and covers about two acres of ground. The continents, rivers, lakes, and oceans are exact small reproductions of those on the Earth. Every wrinkle, mountain, and valley is in perfect proportion. The waters of the Earth are there, too—the Atlantic being about three feet deep.

Boy Land is a school founded by Prince Hopkins; the building of the Earth is his way of teaching geography to his pupils. Mr. Hopkins, who is going to start another Boy Land school at Stamford, Conn., tells us the following:

"When I started my school in Santa Barbara I had a dike built across a little valley. I then said to the boys: 'The pool of water formed by this little dike will represent the Atlantic ocean. We will take a Mercator's map of the world to show us how we should dig the shore lines to make them resemble the shores of America and of Europe. Then we can build boats to sail across, like big steamers that cross the ocean.' We took a map down, and drove stakes into the ground from which to stretch strings from north to south or from east and west, to represent lines of latitude and longitude.

"Next we marked the contours of shore lines by means of a tennis-court marker, and we dug earth from the ocean and lakes to pile up into the mountain ridges. To make this physical labor more exciting, I had a little dredger boat made for them. On its arrival, the boys inspected this boat with great interest. We floated it in the ocean above the dike. A gasoline engine inside, which one boy could operate, ran a little chain of buckets.

"The mechanical efficiency of this machine was low, but its psychological efficiency was high, since digging became much more interesting when carried on to the music of the little dredger chug-chugging near by.

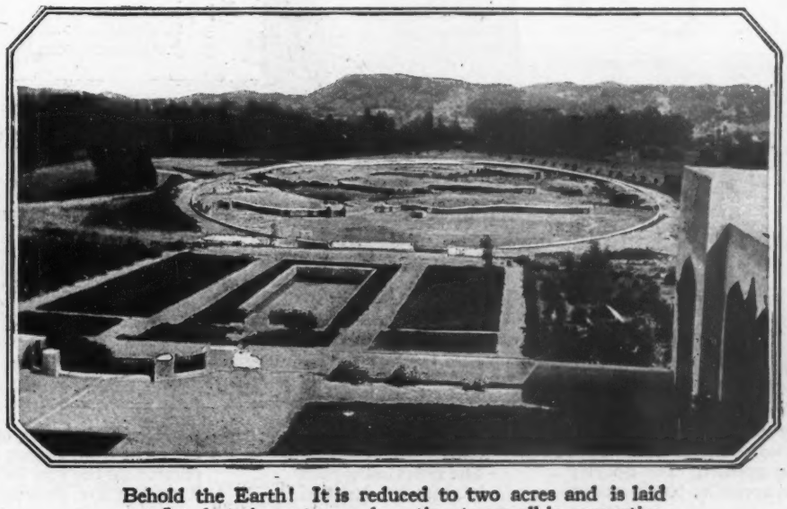
"This dredger engine-boat demanded great attention at the time of the opening of the canals, the boys themselves putting in the Suez and Panama canals.

"A railroad system will connect the series of small cottages at one end of Boy Land with the main cottage at the other end. It will be used not merely as a toy, but as a valuable means of transportation. Things obtainable at the larger building, such as linen for beds and baths, will be taken over on the train, and likewise vegetables, wood, etc., will be taken to the main building.

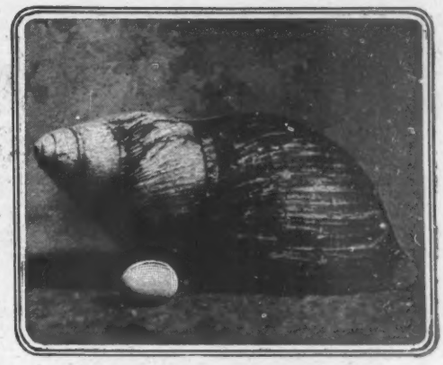
"At Boy Land we sometimes take our history books out on the huge open-air map of the world and there dramatize various events at what corresponds to the very spot where the real life-drama was originally enacted. The main purpose of the map is, of course, to visualize geography. It's large enough so that the boy himself can paddle through the world's chief waterways; and the railroad lines of the various nations are presented in miniature. The boys have, of course, built the ranges of mountains in relief, and have here and there represented agricultural products of the different countries.

"While the map was still in construction a lively commerce sprang up. Little ships traveled along the main waterways, and we began to lay the main trunk railways of the world with toy railroad tracks."

The Pacific Coast is getting its final touches; next the ocean will be poured in



Behold the Earth! It is reduced to two acres and is laid out flat, but the waters and continents are all in proportion



The snail is eight inches long, and came originally from East Africa

A Giant Snail and Her Egg Side by Side

ONE of London's foremost Zoos is very much excited—it has added to its collection some giants. They are snails, and many of them measure as much as eight inches. If you picked one up it would just about fit in your hand.

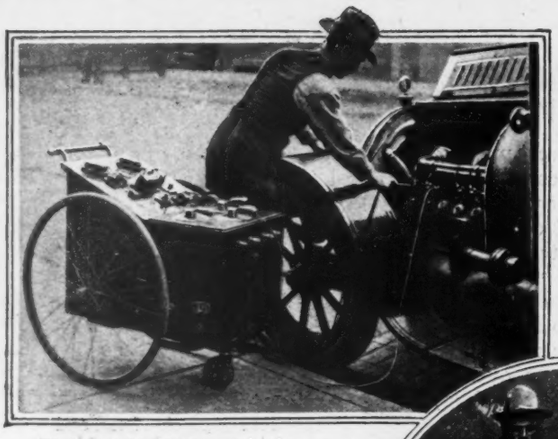
These snails came from East Africa; had they remained there much longer they probably would have been eaten by the natives. Both the snail and its egg are considered delicacies in that far-off land.

The egg of this snail is so large that it is often mistaken for a pigeon's egg. A picture of a mother snail and her egg side by side is shown in the picture above.

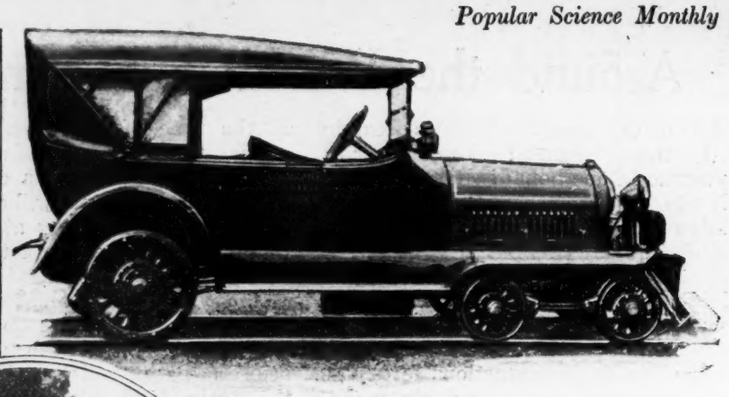
Cultivating Cooties for Scientific Reasons

AN incubator for cooties! Service men might think this superfluous trouble, when so many of the cooties could be freely obtained from the foreign camps during the war. But to study the pest scientifically an incubator for rearing them was required, the investigators devising an arrangement for bringing up great numbers of the lice. The cooties had to be fed, and human blood is their food, so volunteers sacrificed themselves for the cause. As many as four thousand were fed at one time on the forearm of one person.

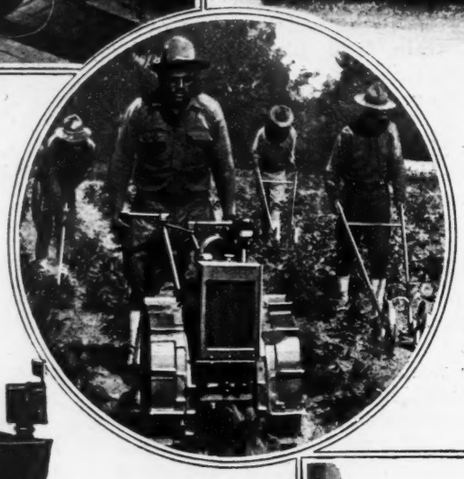
Since it has been found that the germs of several diseases are carried by the cootie, Serbia typhus fever being one of them, the need of incubator methods for enabling scientific study to eradicate the evil is apparent.



The electrical test-cart is the first thing of its kind in the way of a complete apparatus for testing any part of the electrical mechanism of automobiles, trucks, and tractors



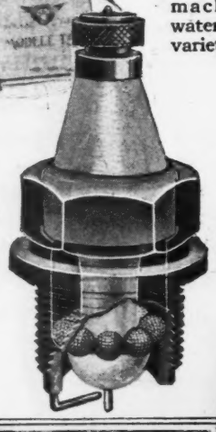
When the government laid up all private cars, a railroad president wanted something to take him over the company's road. His automobile makes sixty miles an hour upon the rails



Things New in the

Here are a few suggestions comfort: choose the ones

One of the most curious exhibits shown in the recent Paris automobile show was a side-car for use on a motorcycle and serving as a side-car taxi-cab



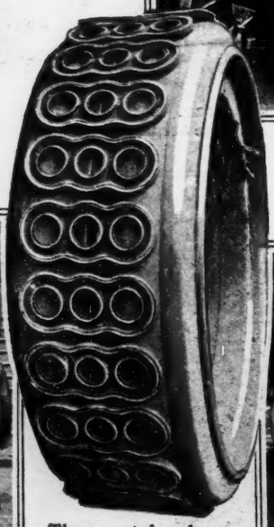
The rough-surfaced balls move up and down by piston pressure, keeping the spark-plug clean

Operated in small spaces this baby tractor was adopted by the government for work in camp gardens. It plows or cultivates, runs a washing machine, pumps water, in fact does a variety of odd jobs

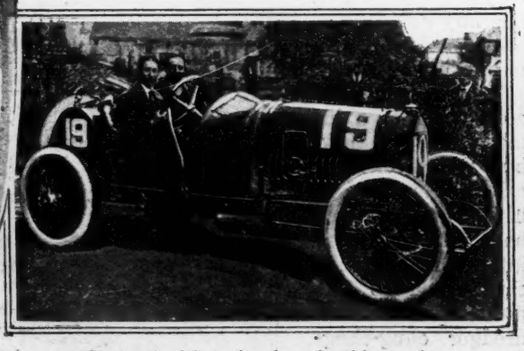
© International Film Service Co.

"A whale of an automobile," you say. You're right, too. A manufacturer took this means to advertise a certain product. Jonah peers from between the whale's jaws

Here is a truck body made from gas-piping. The rear doors are also of pipes, which slide into each other when opened. The novelty of the scheme should appeal to truck-owners



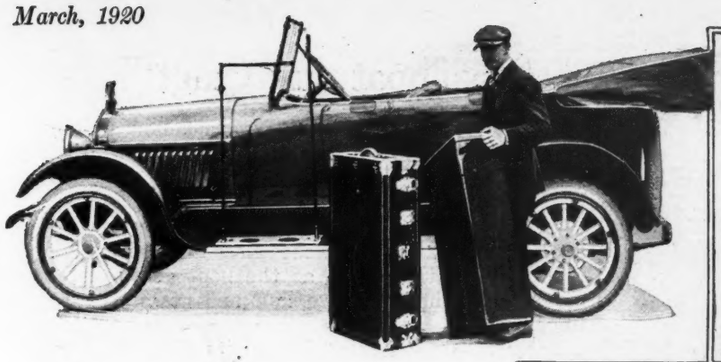
These metal pads encircle the tires and prevent slipping without the usual unpleasant bumping. The holes in the pads increase the traction



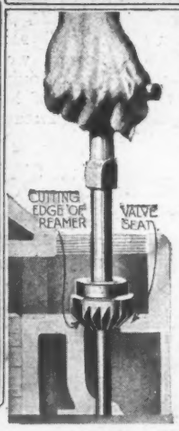
Covered with racing laurels, this aged car came from France to hang up new records for the year 1920. Incidentally it made a fine showing here last year

World of Motors

for your convenience and best suited to your needs



The slidable trunk-holder includes springs which support the trunk so that its contents are not shaken even when the car travels over rough roads



If the windows in your rain curtains tear or break, you can easily purchase others and apply them in a few minutes in the manner shown here

With this simple tool, made of the best cutting steel with a self-centering projection below the cutting edge of the reamer, valve seats may be ground easily, quickly, and cheaply

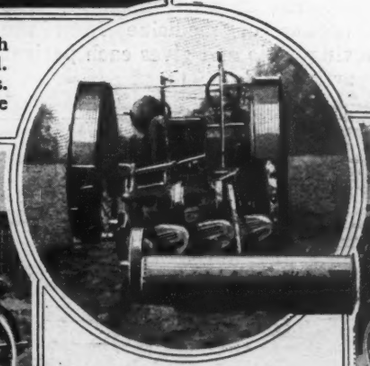
An electric crane swings a ladle before the mouth of the furnace and the clay stopper is removed. The bucket of molten metal is carried to the molds. Thus the automobile cylinder block is made

Instead of a tool-box on the running-board, the 1920 car has a tool compartment in one of the front doors. The flap of the compartment can be locked

Easily transformable into either an ambulance or a limousine, this novel automobile serves a twofold purpose for its renting owner

© International Film Service Co.

With a suitcase strapped on behind the little red wagon, a week-end can be pleasantly spent, especially if the owner is within a few hours of duck country



A heavy roller, having a long arm by which it is attached to the plow frame drawn by a tractor, utilizes a roller much heavier than the ordinary one. The rolling and plowing can now be accomplished in one operation

Prohibition has not yet reached Bombay, India; nevertheless a wine-cask serves as a water container for street sprinkling. The cask is mounted upon a motor-truck. Formerly ox-carts were used

Here is a bread-dough flower in the making; Madame Gatticker does most of the shaping with her hands, but she also uses pincers and scalpels

These realistic artificial flowers were made from bread dough, taken from the heart of hot fresh bread and kneaded into shape

Bread Flowers for Sale Here

DON'T eat fresh hot bread — it's indigestible. If you doubt this, take a piece in your hand and squeeze it. When you open your hand you will have a soggy, heavy lump of dough in it. Madame Prosper Gatticker, of Paris, did this once, and she kept right on squeezing and shaping it until she had in her hand a perfect imitation of a rose. She hardened it in front of the fire and painted it red. And so she began making artificial flowers out of bread dough. She sold them, and turned the money over to the poor.

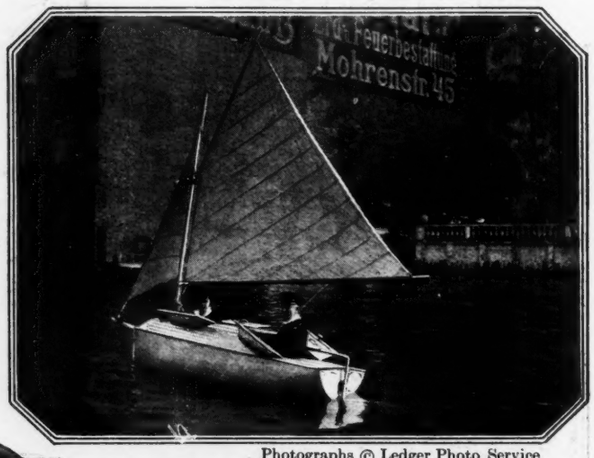
You see, Madame Gatticker is one of the idle rich, and she does this work partly to fill up the time and also to interest her friends in philanthropic work. During the war she sent packages to many lonely soldiers, and was known as *La Marraine Mysterieuse*—the mysterious godmother.

A Sailboat that Can't Sink

BELOW you see a German inventor in his aluminum boat. Aluminum is light enough to make a fast sailing-craft, but this very lightness tends to cause the boat to capsize.

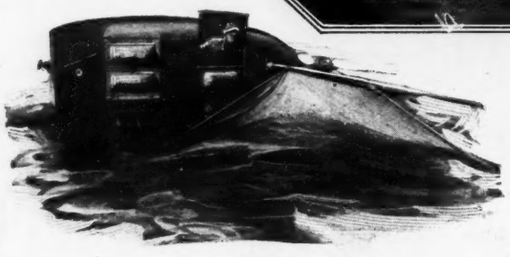
In that case, what happens to the passengers? They are perfectly safe: the hatches close automatically over the heads of the people as the boat goes over. The water forces the lower two shut and gravity drops the upper ones.

After the boat has settled on its side, the inmates open one of the upper hatches and shout for help.



Photographs © Ledger Photo Service

This non-sinkable sailboat made of aluminum was built in Germany



Of course an aluminum boat capsizes easily; but the hatches close automatically as the boat goes over, and after it settles the people within open one of the upper hatches and call for help

This Clock Calls Nurse and Medicine

CLANG! The clock strikes one. A little door above the face flies open.

To let the cookoo out? No; the medicine bottle. You see, the clock is part of a medicine chest for use in hospitals.

The striking of the clock summons the nurse, and when she arrives she finds before her the open door. Inside it there is a small revolving table on which are placed the different medicines that she is to give to her patients at that hour.

Within the chest there are several small revolving tables, one for every hour of the day. Each table is marked with its particular hour. Every morning the nurse puts on the one-o'clock table the medicines that should be given to her patients at one o'clock. She does the same thing for every other hour in the day, and then goes away and forgets all about the bottles until she is summoned by the striking of the watchful clock.

The clock goes round, and as each hour strikes, its corresponding table moves into place in front of the medicine-chest door.

The nurse, on arriving, simply lifts the bottles of medicine from the revolving table and gives each patient his particular dose.

When the clock strikes, a door flies open and a bottle of medicine stands behind it on a revolving table; there is a table for each hour of the day

A Train Helps Out an Airplane

PILOT P. W. Smith was ready to hop off on his daily letter-carrying trip to Chicago, and he went to the shed to get some water for his engine. Alas, he found there was none; the pipes had frozen overnight.

As he stood pondering, the toot of a train whistle sounded in the distance, and in a few minutes a train passed within a hundred feet of the hangar. As it approached the pilot flagged it and told the engineer his troubles.

"Glad to help you out," said the obliging engineer of the train.

The passengers, accustomed to delays, didn't mind this one. Two fifty-gallon tanks, which had held gasoline, were rolled up the railroad embankment and filled with hot water fresh from the boiler.

In a very short time the airplane had started, and the letters it carried arrived on time.

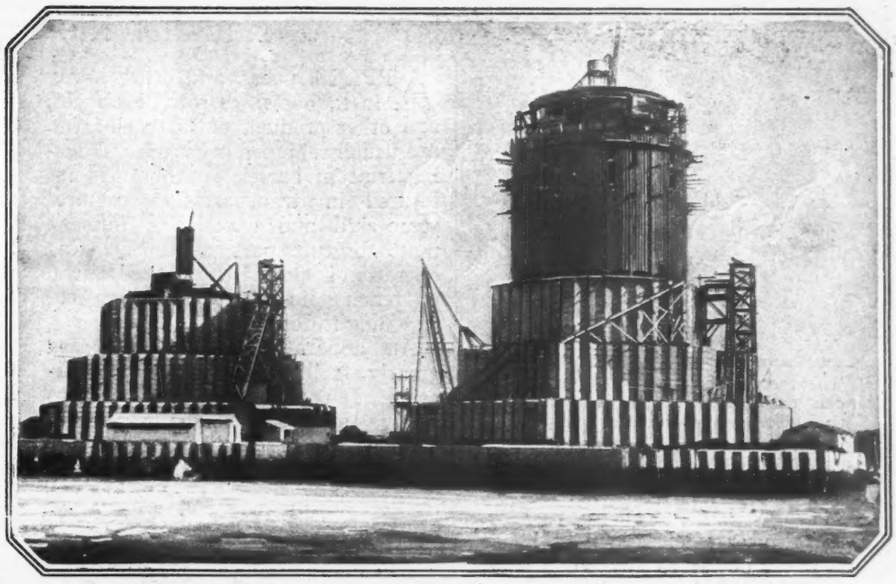
Cleaning Out the Hornets' Nest

WHEN hornets build their nest outside your window, clean them out with a vacuum cleaner, says Mr. A. E. Gardner, of Philadelphia.

"I attached a piece of piping to my vacuum cleaner," says he, "and held the end up under the opening of the hornets' nest; then I turned on the power. Hundreds of hornets poured forth and were promptly sucked down the pipe.

"Later I carefully opened the bag of the cleaner, fearful lest there were some still alive. But they were all dead."

Don't argue with a hornet or you'll be stung. If you wish to empty a hornets' nest get out your vacuum cleaner and simply suck the hornets into the bag



Concrete towers go out after a sunken ship and, with the aid of the tide, are able to drag it inshore; where the tide is not great enough the towers are filled with water and sunk to the depth of the ship

Raising Sunken Ships with Hollow Towers

"A SECOND tower of Babel!" murmured the wondering townsfolk of Southwick, on the coast of England, as they watched the erection of a curious tower-like structure on the beach. The tower was hexagonal in shape. There were four stories, each one sixteen feet high, and the stories receded gradually. On top of all was a great tower. When it was half finished another one was started.

The towers turned out to be great salvage ships, built by the English government for use in raising vessels that were torpedoed in the war. They are so constructed that they can dig up ships that have sunk in water deeper than twenty fathoms.

Each story is made up of hollow concrete boxes four feet square and two feet wide. They are fastened together by steel cables. Thus the whole structure is very strong, and yet light enough to float in fifteen feet of water. Now for the action!

Two of these floating towers are sent out to salvage a ship. Suppose the ship is in fairly shallow water. The towers are towed out and stationed one on each side of the wreck. Divers pass steel hawsers from the towers under the wreck, and make sure that it is held fast.

When the tide is lowest, the hawsers are tightened. As the tide rises, the buoyancy of the towers raises the wreck from the bottom. The whole outfit is then towed inland until the wreck hits bottom. At low tide the hawsers are tightened, and the process is repeated until the wreck is near enough to shore to be patched.

In places where there is not enough tide, water is pumped into the towers and they sink. When the wreck is properly roped, the water is pumped out again. And as the towers rise they take the wreck with them. Old hulks have often been used for this kind of salvage work, but this is the first time that concrete ships have been specially built primarily for the purpose of salvaging.

Tanks in the Sight-Seeing Business

MOUNTAIN climbing is hard work for most people, but easy work for tanks; consequently, many of the French war tanks that are now idle are being made over into sight-seeing buses for use on Alpine mountain roads.

At the right you see a Peugeot tank that has been made over to accommodate ten passengers. While the tank slowly crawls along, the people sitting on top of it can give all their attention to the wonderful scenery about them.

A tank, as you know, can successfully climb over almost any obstacle, and will move calmly onward from a most perilous angle.

War tanks are being turned into sight-seeing buses in France; this one will accommodate ten people, and makes regular trips up the mountain roads in the French Alps

The force and speed of the vibrator can easily be changed by a device that gives twelve gradations of power

How to Cut Down Your Electric Light Bills

EVERY user of electric light has it in his power to cut down his electric light bills by avoiding waste as much as possible. The most radical way of practising economy in the use of light consists in turning off the current when the light is not needed. But often, while the full intensity of the light is not required, there must be some light. For several years there have been in the market electric lamp sockets that make it possible to obtain from two to five gradations of light by setting a switch increasing or diminishing the resistance of the rheostat in the socket.

Recently a new light-regulating socket has been invented with which twelve gradations of light may be obtained by the mere pulling of chains operating the switch of the rheostat. The gradations range from the full light obtainable from a forty-watt lamp to a faint glow of the filament when the current is reduced to five watts.

The Drum that Wears a Wound Stripe

THEY were gathering in the wounded after one of the battles at Verdun, when they came across a drum that had been shot through the head. It was taken to the hospital and given a new one. In a short time it was back at the front, in active service again.

Now that the war is over, the drum has been ordered back to the Marine Corps camp at Quantico, Va. The regiment decided to present it with wound and service stripes—but a drum has no sleeves to wear them on. So the four service stripes were attached to one side of its head, and one wound stripe was placed on the other side.

Packing the Farmer's Fruit

APPLES, pears, and other hardy fruit, beets, carrots, cabbages, and other products of the truck-farm, are usually shipped in barrels. Packing fruit in barrels so that it is not injured in transportation requires some skill and experience, but the most difficult part of the packing operation is closing the packed barrel by placing its head in position and fastening it down.

An apparatus recently patented greatly facilitates this closing operation. It consists of a base shaped to receive the bottom of the barrel, two tiltable posts which support the framework of the closing mechanism, and the lever arrangement by which the head of the barrel is forced down and into the groove provided for it. The barrel to be headed is placed in its proper position on the base, while the posts are in a tilted position, facilitating the placing of the barrel in position. Then the posts are brought to a vertical position, the barrel head is placed on top of the barrel underneath the disk of the closing mechanism, and the lever is pressed down, forcing the barrel head into its groove.

The disk pressing against the barrel head is held in a horizontal position by a cross-frame guided in its up-and-down movements by tubular guide-rods which slide within the two tubular posts supporting the closing mechanism.

After the barrel has been placed in position on the base of the machine, the downward motion of a lever will press the head of the barrel home into its groove

By raising the seat, the teacher can sit in her pupil's place; the pedestal takes up little room

Advocating Pedestals for Students

EVEN if you don't put your child on a pedestal, his school-teacher probably will—for the new pedestal school-room seat is becoming increasingly popular. One child's seat and the desk of the child behind him are mounted on a pedestal, so that either one or both of them may be easily removed.

The pedestal takes up much less room than the usual spreading leg support with its complicated framework. The height of both desk and seat on the pedestal can be adjusted to suit the pupil, and the seat is mounted swivel fashion, so that he may swing it slightly from side to side.

Shot through the head at Verdun, this drum now wears a wound stripe, together with four service stripes; someone has also presented it with a Croix de Guerre

Jumping the Dams with Your Ship

A boat-lifting mechanism that would open waterways now closed

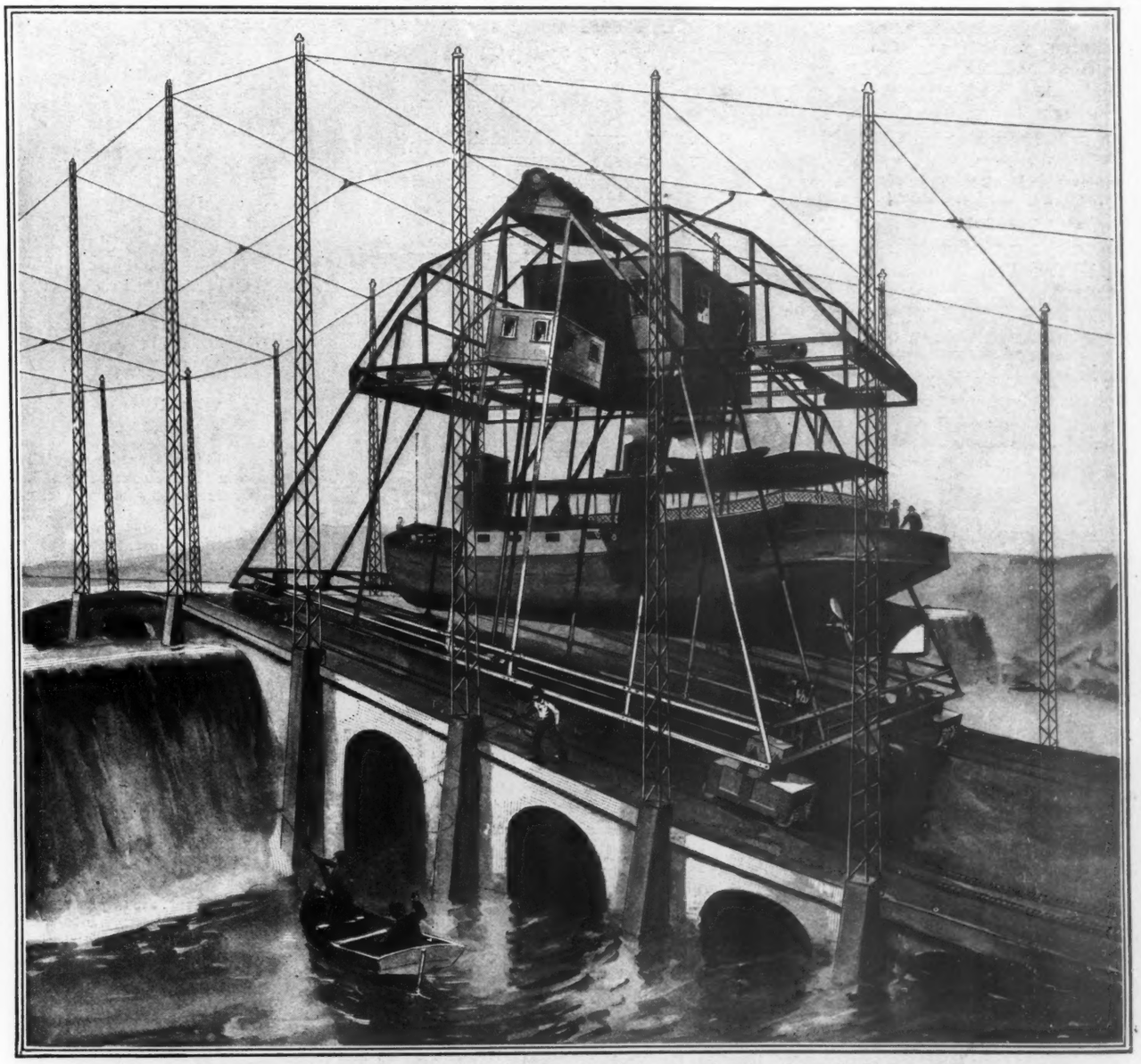
A MECHANICAL fish that can jump a dam is the idea of Johann Jargen Richard Haalck, who emigrated from Stelle, Germany, to this country about ten years ago. Many tributary streams would teem with life but for the spots along their course where canals or expensive systems of locks would have to be built.

The new idea would do away with such difficulties. Only a system of dams needs to be constructed, each dam being furnished with the mechanical contrivance for lifting boat, cargo and all, over the obstruction. Standardized forms of river boats would be used.

The boat-lifting mechanism is a structural steel framework composed of two triangular-shaped side members joined at the top by a horizontal transverse pivot-shaft; on this is mounted a bridge-like cradle. The two sides are made rigid by transverse girders, which also provide for mounting the whole upon four four-wheeled trucks running on a track laid on the bottom of the river and extending up over the dam.

The boat is hung from the overhead pivot-shaft by two bridge-like members that are suitably tied together by cross-girders and provided with a longitudinal track on which run two small carriages with pulleys over which the boat-lifting cables extend downward from the drums in the house mounted midway between the bridge members.

In operation the boat is first floated between the side members and under the lifting platform. Then the small carriages on the lifting platform are moved back or forth until the ropes drop perpendicularly, when they are connected with the special cables attached near each end of the boat. This done, the boat with its cargo is lifted by electrical power bodily out of the water. The framework is set in motion, the gear wheels toothed in the track so they cannot slip. Freedom to swing permits the platform to hold the boat in a horizontal position,



The mechanical arrangement for lifting vessels over obstructions in otherwise navigable streams: the boat, cargo and all, is bodily lifted out of the water and transported over the obstruction

Put Out of the Race by a Pirate of the Air

ATTACKED by a winged pirate, Lieutenant Etienne Poulet, competing in the recent air race from Paris to Australia, had a narrow escape from death while flying above the mountains on the Siam-Burma border. Bad weather had forced the French aviator to proceed at low speed, low for an airplane, and he was flying at an altitude of 1,000 feet above the mountain chain about 100 miles east of Maulmain in Lower Burma, when a huge vulture dropped from the clouds. After circling the machine as if maneuvering for position, the great bird hurled itself at the airplane. There was a crash, a cloud of feathers, and the vulture's body dropped earthward.

But, although victorious in the strange combat, the airplane was badly crippled. The vulture had charged directly into the right propeller. The resulting shock was more than the blades could bear. When it is recalled that in the American trans-continental race one machine was forced down because in a heavy rain-storm the propeller blades were worn away merely by contact with the drops, it is easy to understand the shattering effect of the impact of the huge bird's body. Poulet made the best landing he could in a jumble of mountain peaks. For days he was given up as lost, but he finally succeeded in repairing his machine, and limped into Maulmain —put out of the race by a bird.

The Gum that Gertie Chews

She can still get it for five cents in spite of the increased cost of manufacture

Photographs © International Film Servi

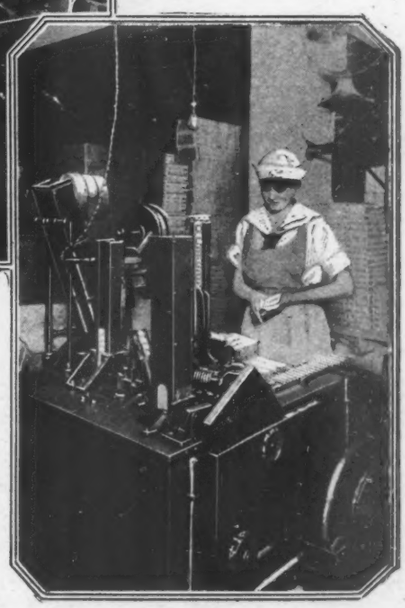
Does Gertie, as she rhythmically works her jaw, ever think of the life of the chicle she chews? It came first from a tree like this. A native boy is shown here cutting intersecting spiral grooves in the bark of the tree; the sap runs down into a bag at the base of the tree. He has been particularly busy since Nellie M. Horton, of Cleveland, Ohio, invented pepsin gum nineteen years ago

You've seen Gertie stretch her gum; but, as you see here, a native stretched it long before it came to her. The stretching is part of the cooking operation. Several bags of chicle are dumped into a large tub placed over a fire. As the water evaporates, the gum is stirred and then stretched to test its concentration

The gum is cut into cakes that weigh twenty-five pounds each, and is shipped from its native land, South America, to factories in its adopted country, the United States. The chewing-gum industry in this country is capitalized at over seventy-five million dollars, and there are at least seventy-five million gum-chewers

The thin slabs of gum are cut on this table. How Gertie must envy these girls their jobs! As for the oil-cans on the shelf, we must admit we're puzzled. Surely chewing gum is soft enough to need no lubrication other than that which the user gives it

The cakes are sliced, flavored, kneaded, and rolled until they are quite thin; then they are run through a thinning-machine. The kneaders dress themselves up like bakers, and the inside of the gum factory looks much like a bakery



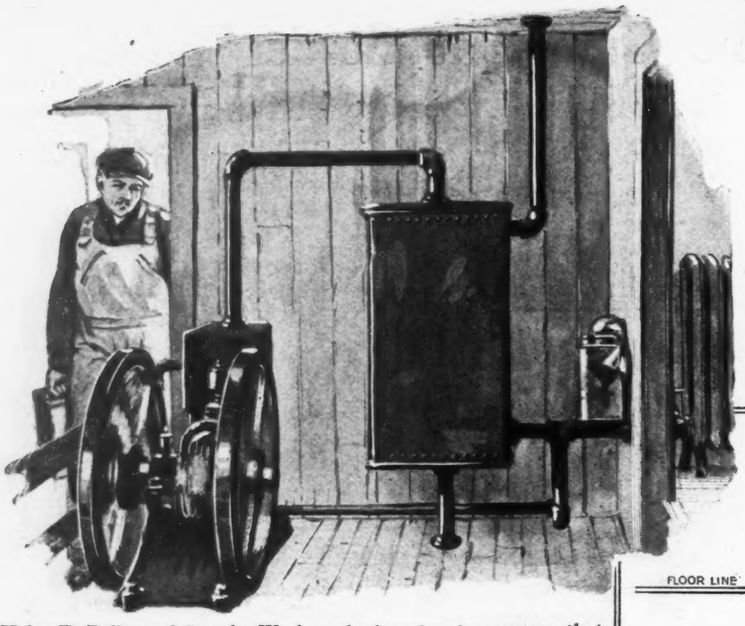
Slices of gum are dropped down the square column in the foreground. The machinery rattles, groans, moves in and out, and soon finished bundles of gum trickle out of a door below. Each slice is wrapped separately, and there are five slices to a package—all for a nickel!

A Few of the Many Done with the Exhaust

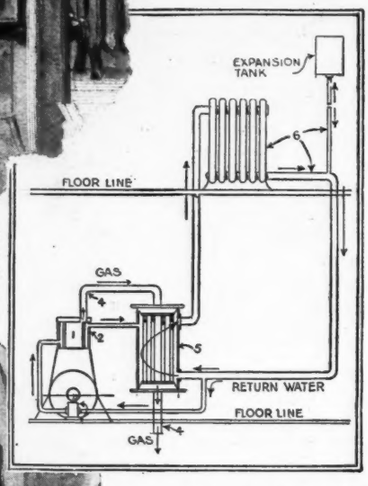
IN its September number the POPULAR *for the best answers to the following question: a Gasoline Engine?"—a first prize of $50, a the thousands of responses that came to the maga- Frank E. Covey for the first prize, the one by that by Clifford A. Butterworth for the third. number of illustrations, in the April* POPULAR *third prize letters are presented below, and in judges, are the next best. The contestants. A new contest*

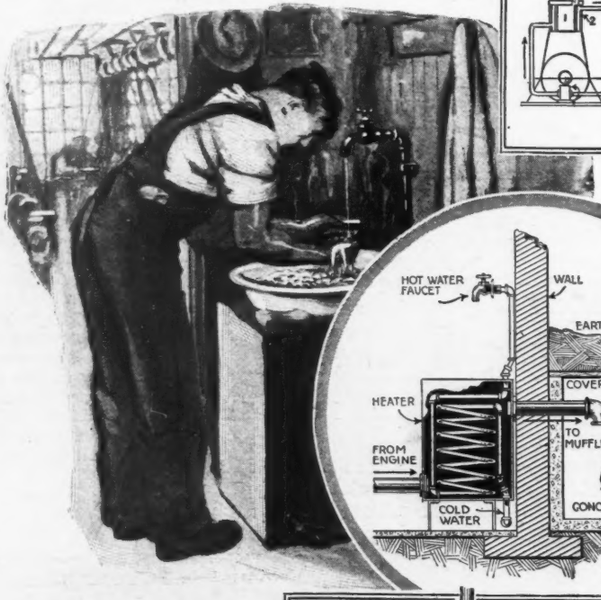
The Winner

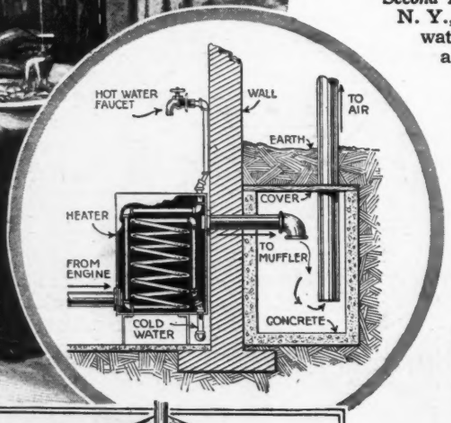
Frank E. Covey, San Francisco, winner of the first prize, submits plans for a complete internal-combustion engine in which the engine's exhaust is delivered to impact turbine buckets on the periphery of the flywheel. This article will be of great interest to the automotive and aeronautical industries. We have decided to give it an entire page of the April Popular Science Monthly



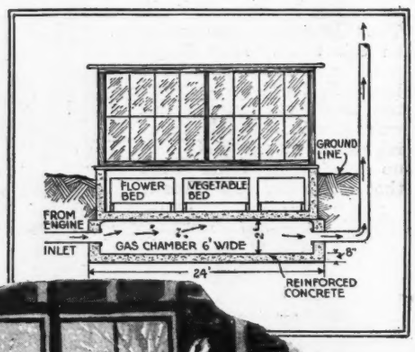
Helen E. Talbot, of Seattle, Wash., submits a heating system that gives a forced circulation of water in the system: 1 is the engine cylinder; 2 the water-jacket; 3 the circulating pump; 4 the exhaust pipe; 5 the exhaust water-heater; 6 the hot water heating system

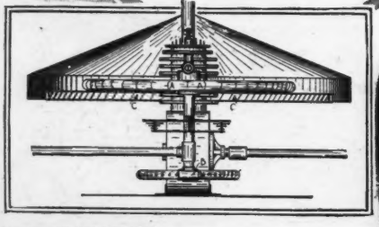


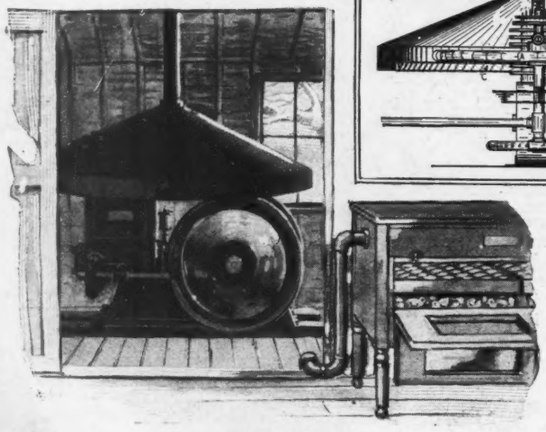


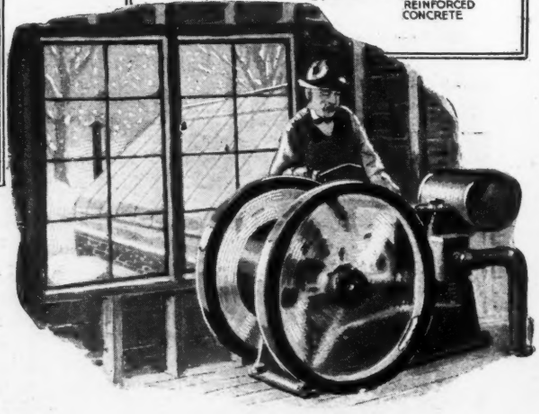


Second Prize. **George M. Petersen, of Niagara Falls, N. Y., tells how to provide a machine-shop with hot water. The heater was made of sheet metal, with a copper coil of the instantaneous type. The cold-water pipe enters the heater at its bottom and runs up to the top, feeding down through the coil so that the direct blast of the exhaust will send it forth hot**







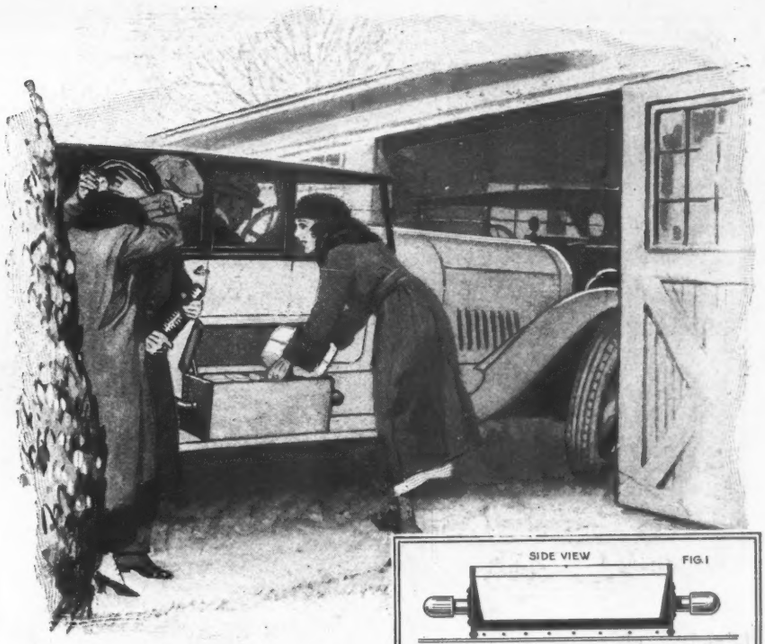


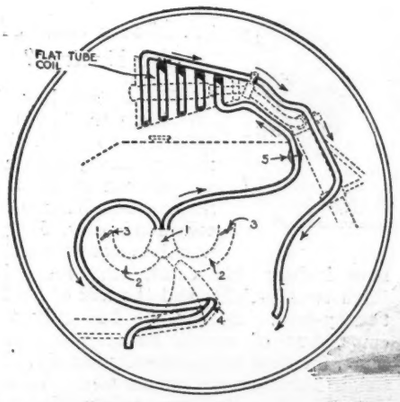
R. U. Clark, 3d, of Barnes Road, Newton, Mass., submits an apparatus for chick-brooding in connection with an air-cooled stationary engine. A small motor, covered with a conical reflecting dome and surrounded by coils of the exhaust, is its main feature

Paul L. Fetherston, of Milton, Wis., suggests plans for a greenhouse to be heated by the exhaust of a forty-horsepower kerosene engine, operated on an average of five hours a day. The heat thus stored is slowly radiated through the floor of the greenhouse

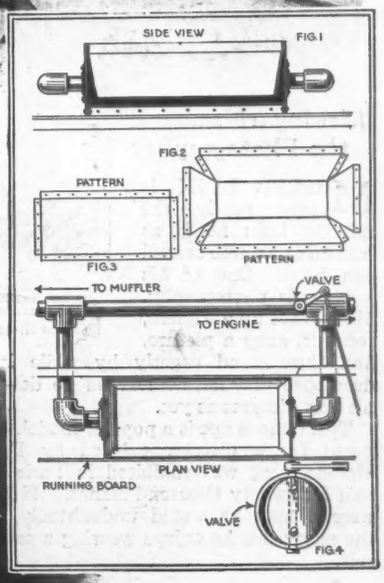
Things that Can Be of a Gasoline Engine

SCIENCE MONTHLY *offered three prizes "What Can You Do with the Exhaust of second of $25, and a third of $15. Out of zine the judges selected the one written by George M. Petersen for the second, and The first prize story will be printed, with a* SCIENCE MONTHLY. *The second and addition the five that, in the opinion of the editors thank both the winning and losing is announced on page 114 of this issue.*

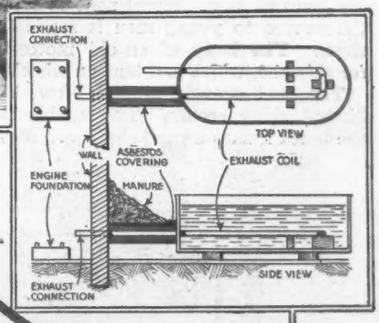


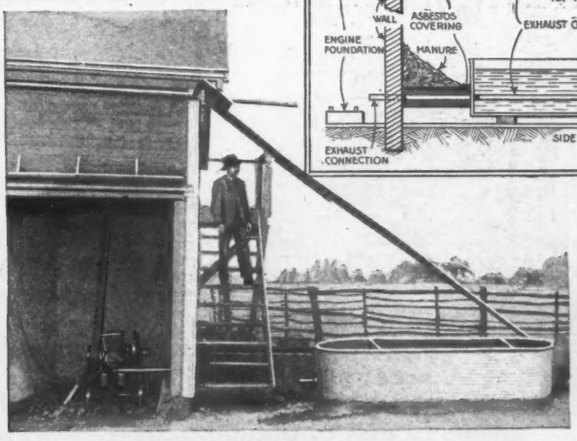


Third Prize. Clifford A. Butterworth, of Newton Center, Mass., made a cooker for touring. The construction is clearly shown in sectional view Fig. 1. Fig. 2 is the food-container, and Fig. 3 is the pattern for the bottom of the case. Fig. 4 shows the heat-regulating valve. The illustration shows how the cooker looks when mounted on the car



"In the cool days of spring and fall," says P. J. O'Neill, of Detroit, "the motorcycle is a very uncomfortable means of transportation, so I decided to utilize the heat from the exhaust of my engine to warm my hands and feet. No. 1 is a 1-inch pipe Y which was reamed to fit two pieces of 1¼-steel tubing; 2 and 3 are butterfly valves; 4 the shield; and 5 a flexible joint





Harry H. Phillips, of Waukesha, Wis., used the exhaust of a stationary engine to keep the water in a cattle-tank from freezing. He ran a single-loop coil of 3-inch galvanized iron pipe to 3 inches of the bottom of the tank, and connected it to the exhaust pipe of the engine. Needless to mention, it worked perfectly

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Making a Monkey of the Photographer

MASTER LINK is very nearly the missing link; he is as human as a dumb animal can be. One of his hobbies is photography. He will set up a camera, focus it, snap a picture, and then stand eagerly by while it is developed—he hasn't learned to develop his own pictures as yet.

This famous ape is a popular model. He posed for a picture, painted by Franz Simons, that was exhibited in Paris and sold for twenty thousand francs. If Link were a man he would undoubtedly join the navy; for he enjoys wearing a sailor's suit.

Tearing Down the Victory Arch

WHEN the war ended, New York built a great Victory Arch across Fifth Avenue; it cost forty thousand dollars. Under it passed New York's returning heroes and distinguished visitors.

But, now that New York has done all the victory parading it intends to, the arch is being torn down.

A Movie Star of the Future?

THE fattest boy in the world lives at Leicester, England. His name is Lenny Mason—yet you can be sure that no one but his mother calls him Lenny. Fatty's waistline measures sixty-nine inches; his chest, sixty-four; his thigh twenty-eight; and the calf of his leg twenty-four. So far, he has only two chins, but of course he may cultivate more, for he is only sixteen years old. He weighs thirty stones, we are told. What's a stone? The dictionary tells us that it is about fourteen pounds. Thus Fatty's weight, translated into United States English, is four hundred and twenty pounds!

Where the Office Seeks the Man

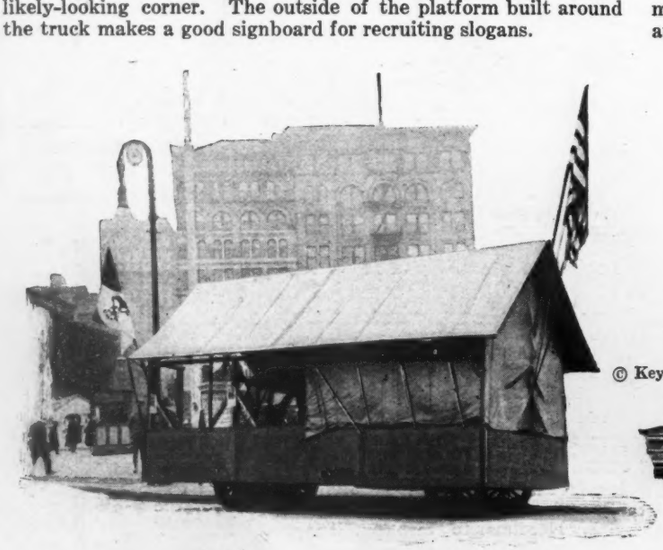
"GO two flights up and see the sergeant," used to be the direction given the would-be soldier or sailor; but a modernized War Department is more businesslike. To "sell" the service to young men it sends the recruiting office out after them. The body of an old motor-truck forms the foundation for this one, which is a tent on wheels.

The tent travels around New York city, stopping at any likely-looking corner. The outside of the platform built around the truck makes a good signboard for recruiting slogans.

Enough Cheese for a Lifetime

A BIG cheese! Most of us have called our enemies that at some time. But did we realize what we were talking about? A big cheese—in fact, the biggest cheese—is shown in the picture below. It weighs more than forty thousand pounds, and is ten feet in diameter.

We are told that it was "built" by Mr. N. Simon, for the National Dairy Show in Chicago. It was held together by metal rods and bands. It was planned to open it at the show and feed it to the public.



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He Put a Rudder on His Sled

SLEDS that are steered by the rider pushing a bar at the front came in just in time to save fathers from bankruptcy as shoe prices soared. But one youngster at least wasn't satisfied with this improvement on the old-fashioned heel-and-toe method of steering.

"My sled just flies down the hill," he was boasting, when his ear was caught by the word "fly." That naturally suggested airplanes, and airplanes as naturally suggested—well, look at the picture. Thus are inventions born. The result was an aerial rudder, which the inventor says is not only good fun, but a real advance in steering apparatus for sleds.

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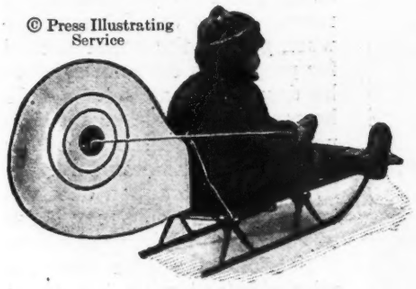

A Trap-Door for Cards

BRIDGE fiends inspired Frederic J. Muspratt, of St. Helier, Channel Islands, to invent a card-table with a trap-door in the center through which the cards may be dropped when each hand is over. Instead of simply picking up the cards and shuffling them, you fish around under the table's edge for a lever, pull it, and wait till all the cards have disappeared before you let go. Then you gather the cards from the tray. The object of the device is speed.

We doubt the efficiency of this trap-door method of gathering cards; but by accidentally moving the lever you might rid yourself of a bad hand.

No Females Allowed on This Holy Mountain

CLINGING to the cliffs at the top of Mount Athos, in Greece, the wooden rookeries shown in the picture above may be considered the most modern thing in cliff dwellings or the most ancient in skyscrapers, depending on the point of view. The clustered buildings house the Rossikon monastery. The population of Mount Athos is about six thousand, of whom perhaps half are monks. Not only women but all female animals are excluded from the holy mountain.

I'll Shoot You a Game of Pool

THEY are making the game live up to the phrase in some New York pool-rooms, where "machine-gun" pool has been introduced.

Inside the barrel of the pool gun is a miniature cue driven by a strong spring. The player places his cue ball in the gun, aims at the ball he hopes to drive into a pocket, and fires. The pool gun has sights to help direct the aim.

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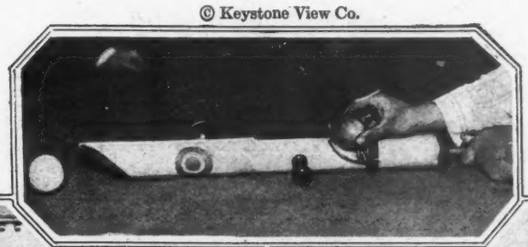


Gid-dap There, Llama

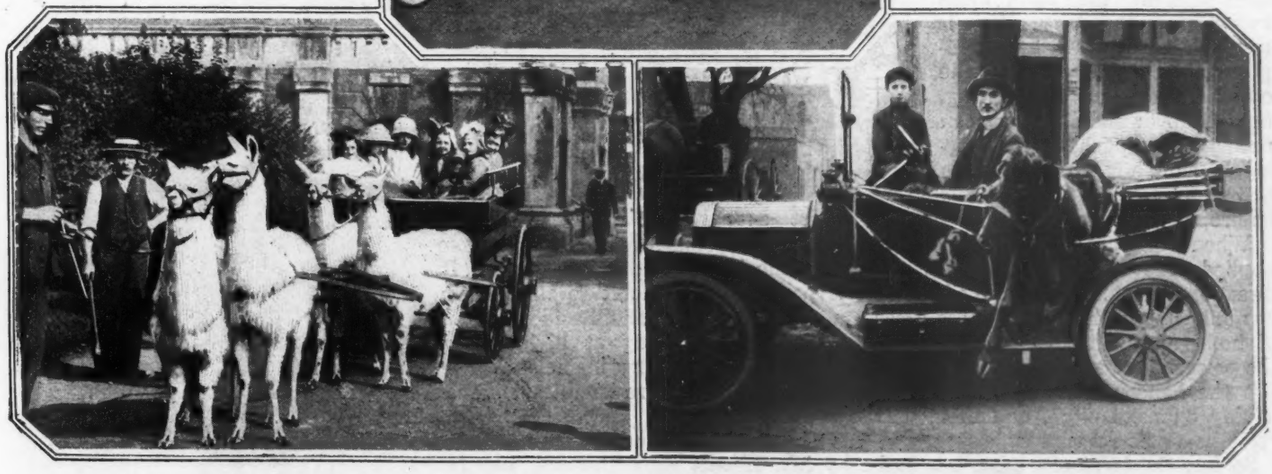
LLAMAS are used in South America as beasts of burden. But when a few choice ones are picked out for foreign Zoos, they quit work entirely and lead a life of luxury—except in some of England's Zoos.

There they are harnessed to a wagon for amusing children. The head keeper of their new home trained them to draw a wagon, and now every day they travel the paths of the Zoo, carrying a load behind them. The llamas may not like it, but after all it is for their own good; we have long been told that "idleness is the devil's workshop."

Josephine the Joy-Rider

BELOW you see Josephine riding in an automobile. Josephine is a cow of the Jersey persuasion, and her chauffeur is a Baptist minister of Bolivar, Mo. A member of his church gave Josephine to the minister on condition that he would carry her home in his car.

Both rear doors of the car were dropped open and the floor between the seats was filled with straw. A temporary chute was constructed, and the cow was led into the car and securely lashed fore and aft. She stood up most of the way home, her feet resting on the running-boards on each side of the car.



Flying Straight Up with Whirling Wings

The helicopter's most recent advocate is the scientist and inventor, Peter Cooper Hewitt

By Marius C. Krarup

A NOTED scientist, Peter Cooper Hewitt, inventor of the mercury-vapor electric lamp, recommends flying on the plan that Leonardo da Vinci said he would adopt if he had the power. In other words, Cooper Hewitt advocates a helicopter, which means that his machine is to be lifted by a screw propeller which rotates horizontally to obtain lift and obliquely to obtain both lift and propulsion. By twirling a toy propeller in the fingers with its shaft at forty-five degrees, one observes that when the blade on one side is in a position that gives lift, the other blade is in a position to give propulsion. By varying the angle of the shaft, lift and propulsion can be obtained in different proportions. The machine goes straight up when the shaft is vertical, and it flies horizontally when the shaft is inclined so that the lift produced is just sufficient to keep the machine suspended.

If only one helicopter screw were used, the engine driving it would spin itself around in the opposite direction. Half the power would be wasted and the pilot much discomfited. The plan therefore calls for two screws mounted on telescoping shafts and driven in opposite directions. For inclining the double shaft at the will of the pilot, one or more auxiliary small screw propellers may be used. When the engine and body of the machine are hung considerably below the helicopters, as in the testing apparatus shown herewith, the push required at the level of the engine for slanting the main shaft can be very moderate. Once the machine flies horizontally by this means, the wind resistance against the body helps to maintain the slant. If it is reversed by the auxiliary propellers, the machine flies in the opposite direction. All steering, up and down and sideways, can thus be accomplished by managing the slant, but Mr. Hewitt does not as yet disclose the mechanism that he proposes to employ for this purpose.

When a surplus of power is suddenly applied, the machine jumps in the direction in which it is aimed, as it has only its weight but no great areas of body and wings to retard it. If the power gives out, the machine falls; but the helicopters prevent spinning, having opposite pitch, and break the velocity of the descent somewhat.

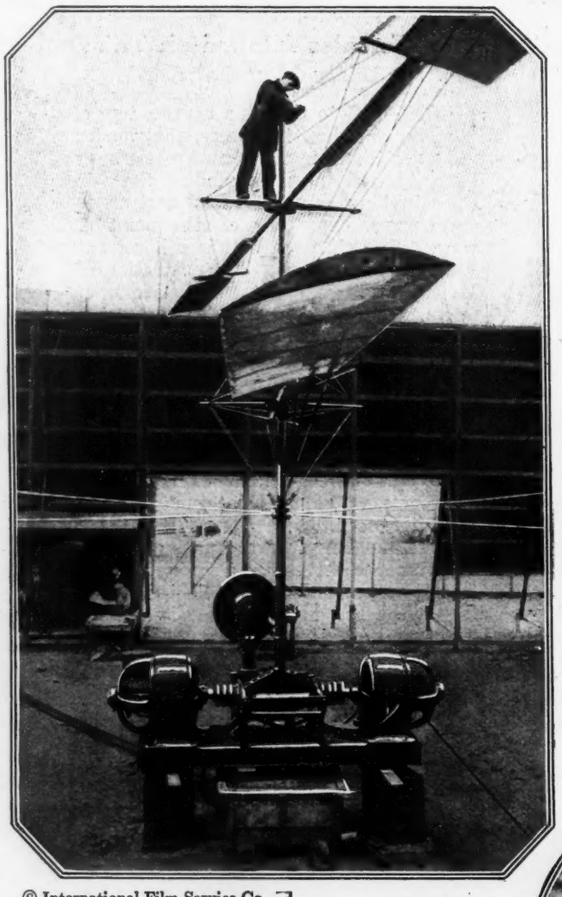
So far, the helicopter plan has had no followers except in theory, mostly because the lift thrust obtainable from an ordinary propeller screw is very small. It is difficult to get more than a 200-pound thrust from an eight-foot propeller at one thousand revolutions a minute. This small thrust will operate at great forward speed when given the chance, as is done in the propulsion of an airplane, but that does not help to lift the much greater weight of a machine straight up, ever so slowly. For that purpose the thrust must exceed the weight. And to use many small helicopters in one machine is practically impossible. It is particularly difficult to slant them all, for propulsion. Besides, small helicopters revolving at high rotary speed are at best very inefficient. The centrifugal forces are troublesome and wasteful.

The extensive experiments made by Mr. Hewitt show the only way in which helicopters can be used. They must be very large. Those shown in the illustration are fifty-one feet in diameter. The four blades are twelve feet long and two feet six inches wide. They are really airplane wings mounted to be whirled around. The maximum rotary speed used is seventy revolutions a minute, but this gives a linear speed of one hundred miles an hour at the middle of each blade.

To get a lift of 2,550 pounds with this machine it is necessary to rotate the helicopter at 70 revolutions a minute and this requires 126.5 horsepower. At 46.5 revolutions a minute the power is more efficient, since at this speed 44.4 horsepower lifts 1,300 pounds, but this lift is not of any use if the machine weighs more. What the lift must be when part of the power is used for propulsion does not seem to be determined as yet. If 126 horsepower is required for supporting a machine weighing 2,550 pounds and more for flying it, the helicopter plan does not yet promise an efficiency equal to that of an ordinary airplane.

The following table gives results obtained with the Peter Cooper Hewitt helicopter testing apparatus:

Revolutions per minute	Lift in pounds	Horsepower	Pounds of lift per horsepower	Velocity in feet per second at 20-foot radius
46.5	1300	44.4	29.3	97.5
56.5	1800	75.4	23.9	118.3
63	2150	98.4	21.8	132
70	2550	126.5	20.2	146.5



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P. C. Hewitt's helicopter test machine. When the electric motors are replaced by engine and auxiliary propellers for starting the helicopter mast, and when room is made for a pilot, this apparatus becomes a flying-machine

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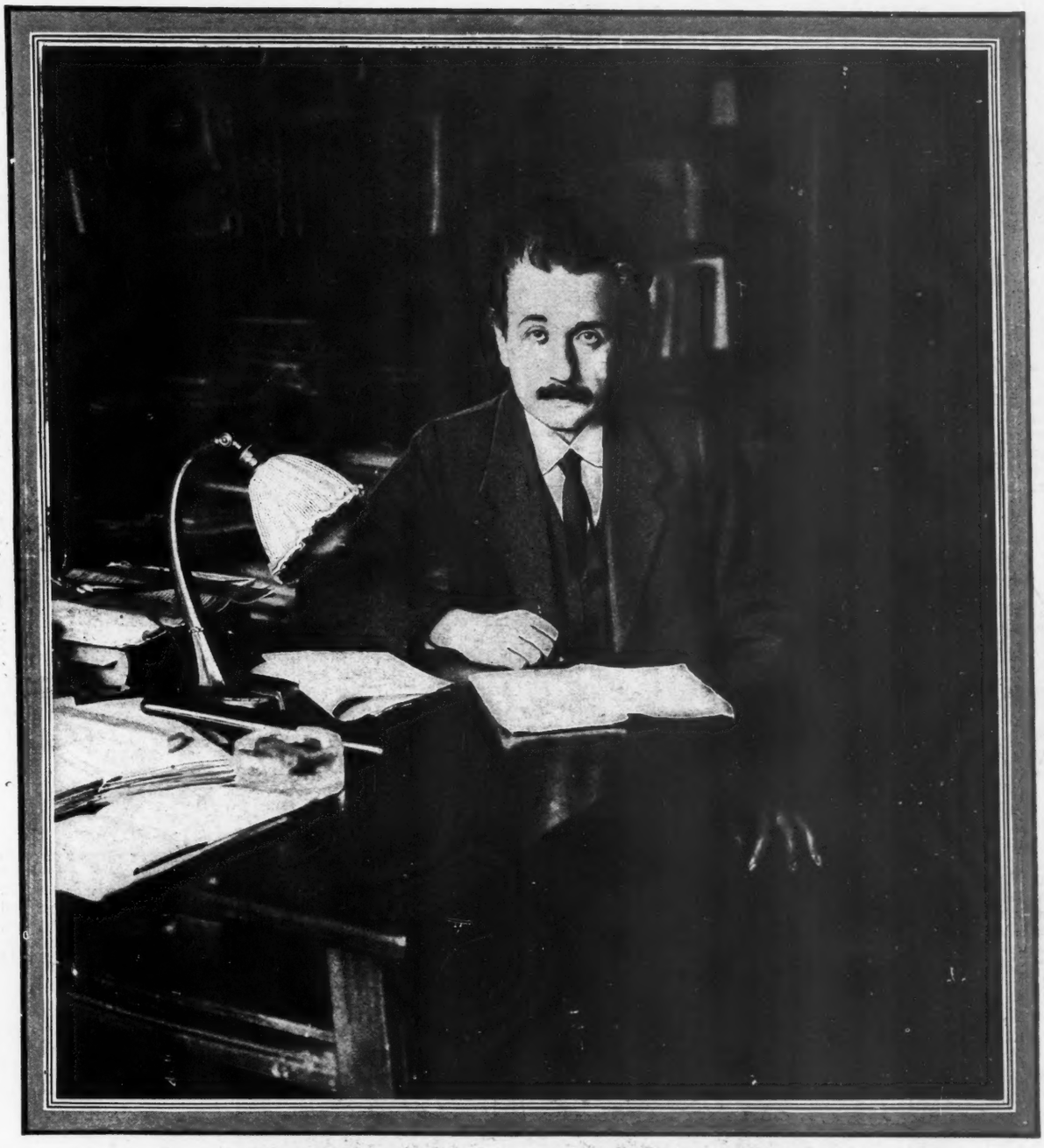
During a recent test of his helicopter flying-machine, Mr. Hewitt was accompanied by Thomas Edison, who displayed a keen interest in the invention



Once They Would Have Burned Him at the Stake

MEN have been tortured and burned at the stake for upsetting ideas. Galileo and Copernicus had a hard time of it in their day. Now comes a revolutionist, an idea-upsetter as great as any. He is Professor Albert Einstein, and his idea-upsetting "theory of relativity" will make it necessary to rewrite Newton's laws of gravitation and every text-book on physics.

Einstein starts with two suppositions. One is that all motion is relative. In the cabin of a ship you cannot tell whether you are moving or not without looking out of the window. Is a man who is walking from stem to stern of a ship at the same rate that the ship is moving in the opposite direction standing still or not? If astronomers could not see the stars, they would not know that the earth is moving.

Einstein's second supposition is this: The speed of light (186,000 miles a second) cannot be increased or diminished. This is like saying that the speed of a rifle bullet is always the same when it is fired forward or backward from an airplane going at one hundred and twenty miles an hour. Nothing can be faster than light. Newton says that gravitation acts instantaneously throughout space. "No," says Einstein, "the action of gravitation is not instantaneous; it cannot exceed the velocity of light."

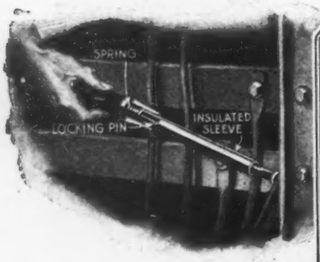
What is your size? What is your shape? "Tell me how fast you are moving and in what direction," says Einstein, "and I will answer. If you are traveling vertically upward at the rate of 136,000 miles a second, you are not six feet tall, as you supposed, but just three. But horizontally you will measure six feet. It is no use to bring in a standard yard-stick and start to measure, for that too contracts and measures only a half a yard vertically held."

Light is a form of energy. Therefore, says Einstein, it must have mass and must be affected by gravitation. In other words, you ought to be able to weigh light. But how? It moves so fast that it cannot be weighed on the earth. If we could see a star close up to the edge of the sun, a ray of light coming from the star would bend under its own weight, and the star would be seen, not where it actually is, but a little bit to one side. During the last solar eclipse exactly what Einstein predicted happened. A light from a star was deflected, just as a bullet fired from a gun gradually curves toward the earth. We can safely speak of a pound of light now. As a matter of fact, the sun showers on the earth 160 tons of light daily.

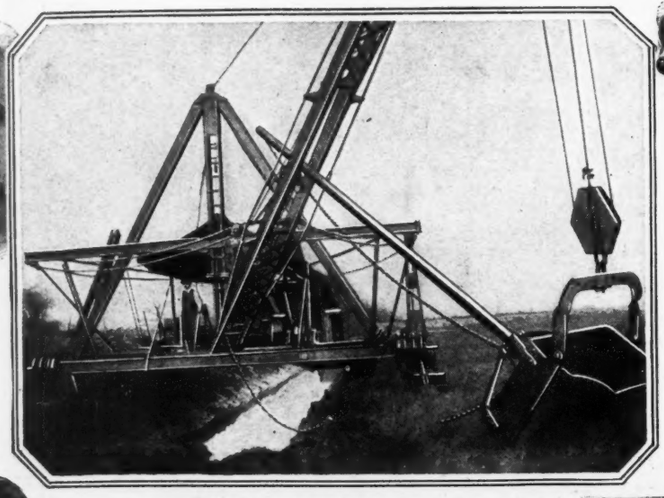
Other astonishing consequences follow as soon as Einstein's theory of relativity is accepted. Straight lines do not exist. They are parts of gigantic curves. Travel fast enough on a straight line, and you will come back to your starting-point. It would take a beam of light 30,000,000 years to describe a complete circle.

All this seems like sheer nonsense. *And yet, Einstein's statements have been proved to be true by experiments!* You have been living in a dream world. Your conception of time and space are true only within limits. "Wake up," says Einstein, "and acquaint yourself with the real world."

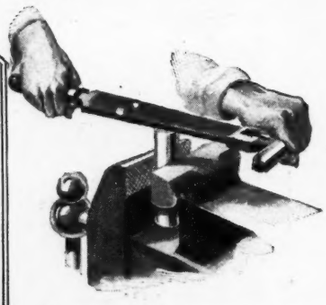
Do It with Tools and Machinery



John Weaver, of Baltimore, has invented a completely insulated screwdriver, something that has long been in demand by the electrical trade. Should the device slip on live circuits, it is rendered harmless by its insulated shield



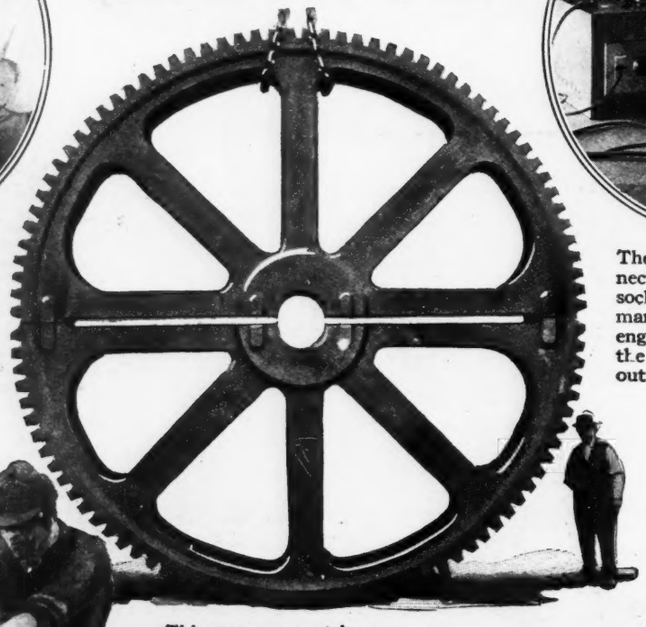
A transporting attachment permits the dredge to be propelled backward with the same facility as forward. The dredge rests upon skids on top of which are steel rails, the skids sliding forward by belt and pulley power from the engine of the dredge



A recent improvement is this extra handle to be attached to a file and permitting it to move backward as easily as it does forward

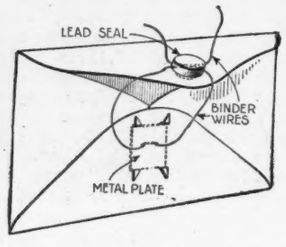
A grinding-wheel dresser, so made as to produce the proper form of wheel for grinding various radii, has recently been placed upon the market. The illustration above shows the dresser in operation

The operator plugs the connecting cord into the light socket, lays the metal to be marked upon the electrical engraver's contact plate, and the engraving is made without wax, stamps, or acid

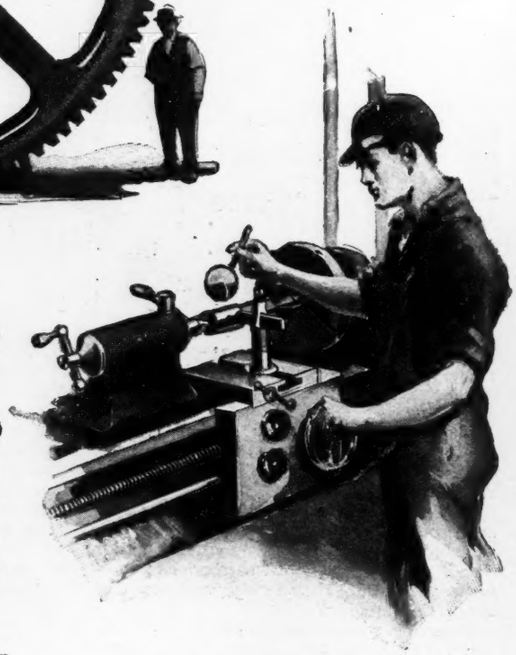


This gear was cast in one piece and then cut in two. Its diameter is 16 feet 8 inches, and its weight 70,000 pounds. The teeth are 28 inches across and there is room for a man's arm between two of them

Driven into the tree to be cut down, this saw oiler lubricates the saw automatically as it passes back and forth beneath it

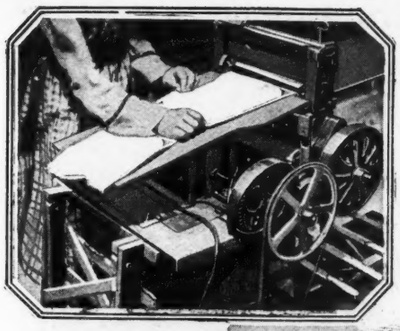


A clip that is shaped from thin metal and provided with prongs for securing the back part of an envelope or binder

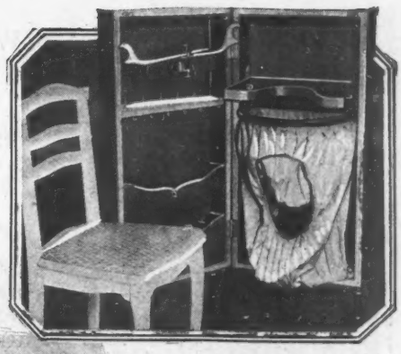


A magnifying mirror for shop use: it is adjustable to any angle, and can be inserted in a surface gage or other instrument

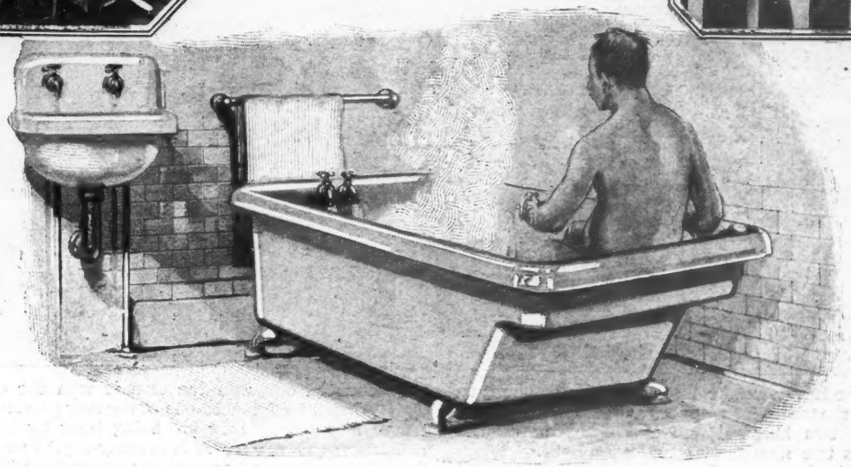
Inventions that Will Help Make the Housewife's Job Less Hard



Here is an electrically heated clothes-mangle: attached to the washing-machine wringer; it is said to do the family ironing in one third the time formerly taken



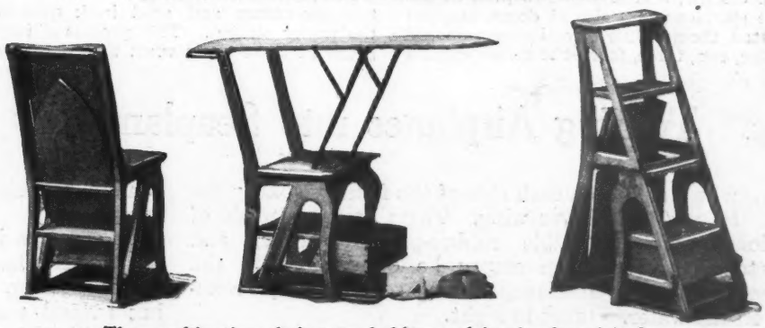
This little sewing-stand, with its hanger places for spools, scissors, and sewing material, folds up exactly as would a book, and hides behind the door when not needed



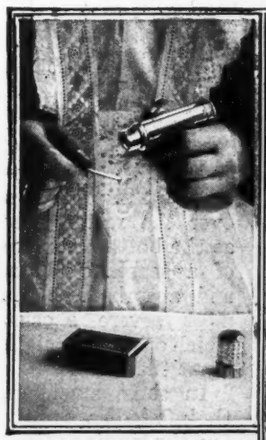
A new bath-tub is so designed that it offers the occupant either a head-rest or a seat at one end of the tub

An unusual but very practical soap-holder is shown here. The cake of soap is simply set upon the prongs, which prevent it from slipping

For the theater and the home is this automatically closing bag, hat, or program holder. When not in use the spring lug snaps back into the pear-shapedholder



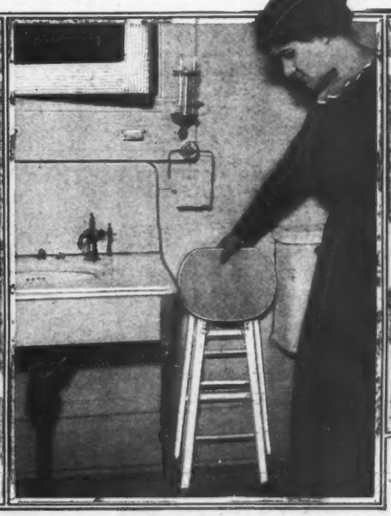
The combination chair, step-ladder, and ironing-board is for the two-by-four apartment. It is entirely practical and saves buying three separate kitchen articles



The fumes of burning benzine cause the metal in the perforated box to glow for eight hours at a time, making this little hand-warmer a useful thing in the cold weather

© International Film Service

The ashes from the kitchen range are placed in a sifter built almost like an ice-cream freezer: The sifter is made air-tight



This folding stool for the bath-room is set compactly against the wall, out of the way, when not in use: Very useful in small bath-rooms

Push down the pin, insert the rubber cork into the neck of the bottle, release the pin, and the cork will expand sufficiently to cork it: It will fit any bottle of reasonable size

A Fight between a Steam and an Electric Engine

THE fight for the heavy-weight championship was about to start. Down the tracks from opposite directions came the fighters—a great two hundred and sixty-five ton electric locomotive versus two monster steam locomotives. When the gong sounded, the steam locomotives started up and shoved the electric one down the track. Then the power was turned on in the electric, and it began to push in the other direction. The steam engines slowed down, stopped dead, and then retreated, though their throttles were opened to the last notch! One, two, three, four—the steam engines were counted out, and the electric won the championship. This powerful engine is one of the new gearless electric passenger locomotives that are being built by a large electric company at Erie, Pa. It is seventy-eight feet long, eighteen feet high, and has a horsepower of more than three thousand. There are fourteen motors that turn fourteen sets of driving wheels. And these motors may be used as electric generators and send back quantities of "juice" to the power station. This process of regeneration acts as a brake at those times when the engine is traveling downhill

Turning Airplanes into Seaplanes

IMAGINE yourself aboard an airplane, crossing a wide stretch of water. You are enjoying the scenery, when suddenly the motor begins to stutter. A few half-hearted explosions, a grating sound, and—the engine stops. If you are flying low and far from the shore, you must face a landing on the water.

Lower and lower soars the airplane; the wind whistles past the bracing-wires—suddenly the machine hits the water with a tremendous crash. Half a wing is carried away by the waves. But you are safe—for the time being. In a few minutes the machine settles lower and lower in the water. Then, when you have given up hope, a hum is heard in the sky, and a giant flying-boat lands close to you and takes you off the wrecked airplane.

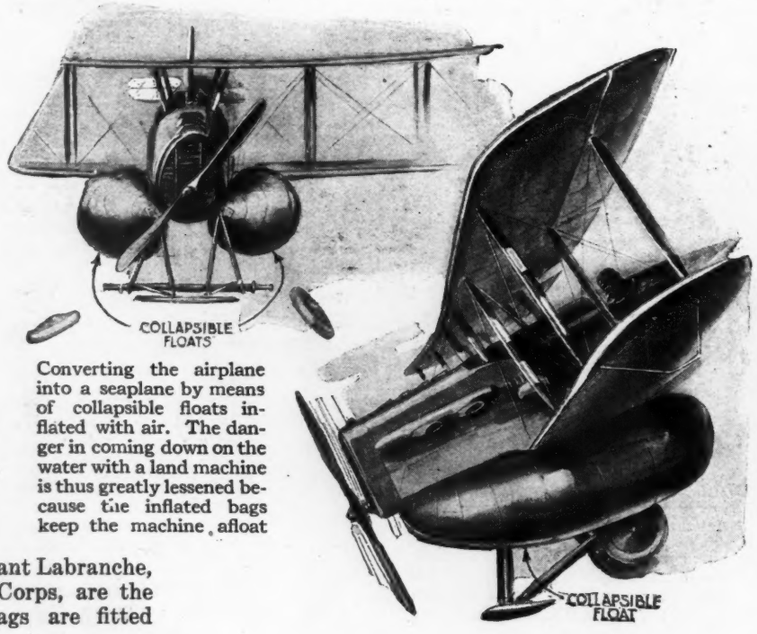
Buoyancy bags, a new invention, will soon be found on every machine that has to traverse wide stretches of water. Colonel Busteed, of the British Air Service, and Lieutenant Labranche, of the French Aviation Corps, are the inventors. Two air-bags are fitted on each side of the fuselage, under the lower wing. These bags are made of flexible rubber-proofed fabric, and when empty lie quite close to the fuselage, offering scarcely any resistance in flight.

The bags are inflated by means of an air-bottle containing compressed air under a pressure of 2,000 pounds to the square inch. Since the bottle is very small, to save weight, it does not contain sufficient air to fill the bag completely.

In order to increase the volume of air, a very ingenious device, known as an injector, is used. This injector has several nozzles which communicate with the outside air; when the valve on top of the steel bottle is opened, air rushes at tremendous speed into the injector and then into the bag, which becomes rigid.

A landing vane, about one foot wide and five feet long, is fitted in front of and below the air-bags. This glides over the water, just as the bottom surface of a seaplane floats, and absorbs also the most severe shocks, which otherwise might burst the air-bags.

In some machines, the inflated bags might foul the landing wheels of the airplane; a special device is used in such cases, which enables the pilot to throw the wheels off just before inflating the air-bags.



Converting the airplane into a seaplane by means of collapsible floats inflated with air. The danger in coming down on the water with a land machine is thus greatly lessened because the inflated bags keep the machine afloat

Ripples of Life and Waves of Death

The world is full of them; waves visible and invisible, waves inconceivably short and immeasurably long

By Alfred J. Lotka

YOU may whisper in her ear or you may wireless to her in Honolulu; it makes no difference—it is only a ripple, anyway.

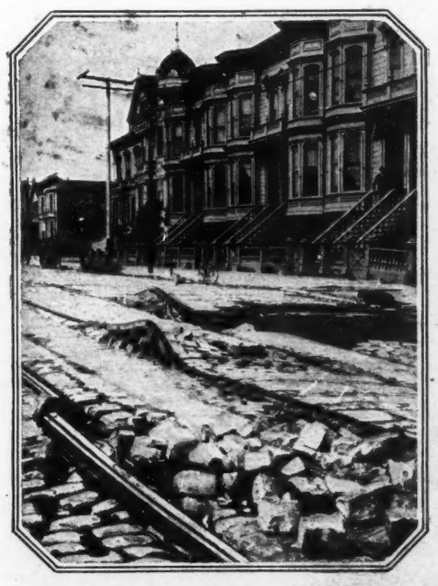
I am not speaking of the *substance* of your message, but of the *means* by which it is conveyed. In either case, it is carried to its destination by a wave. Of course, there are waves and waves. A whisper is a sound wave measuring only a few inches from crest to crest, while the electro-magnetic waves used in wireless telegraphy may be several thousand feet long.

The world is full of waves—waves visible and waves invisible; waves inconceivably small; waves of ordinary dimensions; waves so long that the imagination stands aghast in the effort to picture them; waves in the water, waves in the air; waves in the solid earth, and waves in the empty space between the stars.

The most familiar of these are the waves on water. Look at water waves and you can form a mental picture of some others that occur in nature—most of them either quite invisible, or else visible only under very special circumstances.

If you throw a stone into a pond, an ever-widening train of circular waves spreads in all directions. The waves, then, in this case are circular and are propagated in two dimensions only, for they cannot leave the surface of the water and travel out into space.

If you throw a stone in a pond, an ever-widening train of waves spreads in all directions. The waves have two dimensions only. A somewhat similar wave action takes place when you strike a bell



Probably not a day passes without an earth wave. Fortunately, most of these are very slight. This picture shows car-tracks and cobblestones torn up by a recent earthquake

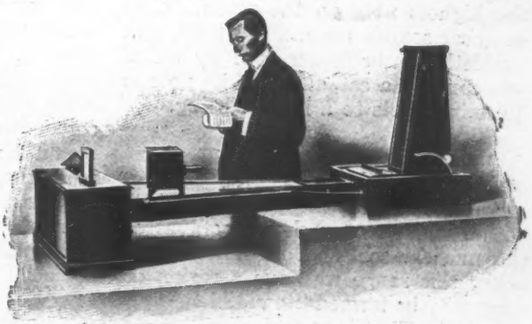
Making Your Eyes See Sounds

Something similar happens if you strike a bell, for example. The bell is thrown into vibration by the blow: you discover that if you touch the bell with your finger immediately after striking it. The vibrations of the bell are communicated to the air around it, and a wave ripples out in all directions. If it reaches your ear you say: "I heard the bell strike."

In this case, if there are no obstacles, the sound spreads approximately evenly in all directions; in other words, the waves are not circles, but spheres. Though your ear detects these waves, they are ordinarily quite invisible. Yet you can be made to see them by special devices. Professor Foley, of Indiana University, has obtained some exceptionally fine photographs of sound waves. As a sound wave in air moves at a speed of about 1,100 feet a second, or 750 miles an hour, and as it is quite impossible to point your camera and work a shutter by following the wave with the eye, it requires special ingenuity and skill to secure a photograph. The feat is accomplished by pointing the camera at the source from which the sound proceeds, and making a flash of intense light immediately after the sound is produced. The particular sound used in the experiment is the loud crack of a powerful electric spark, and the flash of light is given a very small fraction of a second later by another electric spark sprung between magnesium terminals to render it intensely luminous.

Try It on Your Piano

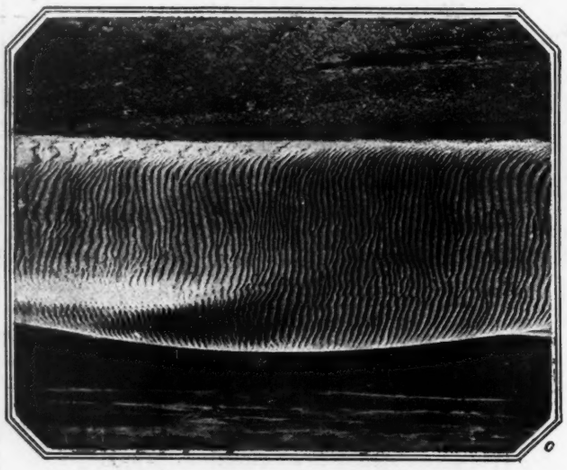
Just as the waves on water vary in height or amplitude, and also in length as measured from crest to crest, so sound waves differ in amplitude or loudness and also in wave-length or musical pitch. An ordinary piano keyboard extends from the note *A* three octaves and a half above the so-called "middle *C*," the note on the first ledger line below the staff in the violin clef and four octaves above this to the top note of the piano, again a *C*. The string that sounds the middle *C* vibrates 273 times a second at concert pitch and sends out waves measuring $\frac{1100}{273} =$ 4 feet in length. The wave length is halved every time we go up one octave. Hence the wave length of the topmost note on the piano, four octaves above the middle *C*, is $\frac{4}{2^4} = \frac{4}{16} = \frac{1}{4}$ ft. = 3 inches. Similarly, the wave length of the lowest note (*A*) on an ordinary upright piano is nearly 39 feet. The



The earth writes its autograph with this instrument—a seismograph. Daily waves in the earth are thus written down for the scientist to study

lowest note on some of the largest organs is the *C* an octave and a half below this, sounded by a 64-foot open pipe. Its wave length is 128 feet, and it gives only 8½ vibrations a second.

It is doubtful whether the ear truly recognizes the pitch of the notes at the extreme ends, both above and below, of the full range of a great organ. Even on the piano it is difficult to recognize a melody played, say, on the three lowermost notes. And if we go a little further down the scale of vibrations, we cease to recognize them as sounds at all—at most, we may become conscious of a kind of rumble. At the upper end of the scale, too, a point is first reached where we are unable to distinguish musical pitch, where we can still hear a note, but are unable to place it in the musical scale. Then beyond this come vibrations that the human ear does not perceive at all. This limit of audibility varies considerably in different persons, but corresponds to a frequency of about 24,000 vibrations a second or a wave length of one half inch, a note two or three octaves above the highest note on the piano. Cats can hear sounds beyond this limit, and a whistle can be constructed by which you can call a cat, although its note is quite inaudible to a human being.



This looks like the back of some great wriggling reptile. In reality it is nothing more than a harmless stretch of sand ruffled up by the wind. The waves occur with almost unbelievable regularity

Sounds that You Can't Hear

Audible sounds, then, are comprised within some ten or eleven octaves of the musical scale. Both above and below this range we have a region of what may be termed "inaudible sounds." That is to say, there are waves that, just like the audible sound wave, consist of alternating layers of compressed and rarefied air traveling out from a vibrating body, but to whose wave length our ears are not attuned.

Is there any limit also to these inaudible sound waves? The answer is that there is, at any rate, an upper limit, for a wave only one tenth of an inch long can be started, but by the time it has traveled about an inch its intensity ("loudness") has fallen off to only one hundredth of its initial value. Such exceedingly short waves, then, if they occur at all, can never travel more than a very short distance. In contrast with this, sounds of ordinary wave length have been heard over very long distances. Thunder may sometimes carry as far as twenty miles. In the World War the boom of big guns was heard at a distance of more than three hundred miles. In the year 1883 the top of the Krakatoa mountain in the East Indies was blown off by a terrific volcanic explosion which was heard for fifteen hundred miles.

The water upon the earth and the air of the atmosphere are very mobile bodies, and perhaps we would naturally expect that they should be constantly thrown into vibration or wave motion.

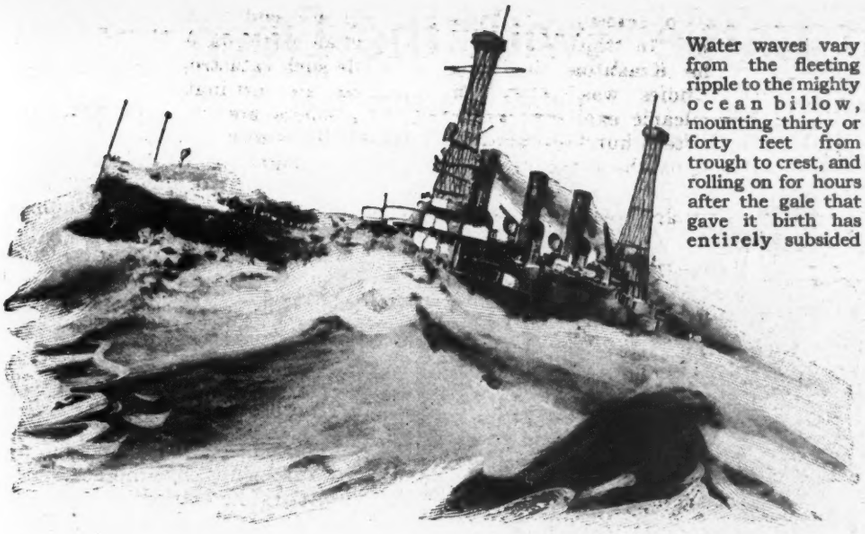
Even the solid earth itself is not exempt, although powerful earth waves are fortunately of rare occurrence in most localities; I say fortunately, because when they do occur they are absolutely the most deadly of all catastrophes in nature. It is estimated that in the earthquake of Messina in 1908 about 100,000 people were killed, while 300,000 are said to have perished in the Indian earthquake of 1737.

While such catastrophic convulsions as these are fortunately rare, minor earth tremors are very common, especially in certain localities. They range from slight but easily perceptible shocks to fine vibrations detected only by delicate instruments, so-called seismographs, constructed especially for this purpose. Even in New York, whose immunity from serious earthquakes is attested with picturesque eloquence by its sky-line of tall buildings, the seismograph of the Museum of Natural History is seldom idle. Probably not a day passes without an earth tremor, such as a delicate seismograph would record, taking place somewhere on our globe. It is hoped that in the course of time the observations gathered with seismographs and by other methods will enable us to foretell the advent of severe earth-shocks, and to warn the occupants of the threatened territory.

A Bridge that Was Destroyed by Walking Horses

The subject of vibrations in buildings and other engineering structures is of interest also quite apart from the often only remote possibility of earthquake disturbances. The sway of a tall structure, such as a factory chimney, under the wind may attain an amplitude of several inches. Nor does it necessarily require a large force, such as high wind pressure, to produce very serious oscillations. You know that by properly timed pushes a small child can gradually set into

Even fog comes in waves. You do not see the waves when you are in the midst of it—but if you stand above it on a mountain-peak, the top of the fog will look like a rippling ocean. There are waves in water, in air, in the solid earth, and in the ether space between the stars



Water waves vary from the fleeting ripple to the mighty ocean billow, mounting thirty or forty feet from trough to crest, and rolling on for hours after the gale that gave it birth has entirely subsided

motion a swing with an adult sitting in it. This is a typical example of what is called resonance. The swing has a certain natural period of vibration, just like the pendulum of a clock, which makes one, two, or more beats every second, according to its length and the construction of the clock.

Now, this is a perfectly general property of bodies or systems capable of vibration—that they have a definite period of oscillation, depending on their dimensions, and that, if the proper kind of force is applied at regular intervals corresponding with their natural period of vibration, even a small force is capable of producing very powerful effects. This is the reason why troops marching over a bridge are always ordered to break step. Were they to march in unison it might happen that their footsteps kept time with one of the natural periods of vibration of the bridge or some of its members. Serious results might then follow. A suspension bridge at Manchester, England, many years ago actually collapsed under the hoofs of a troop of cavalry.

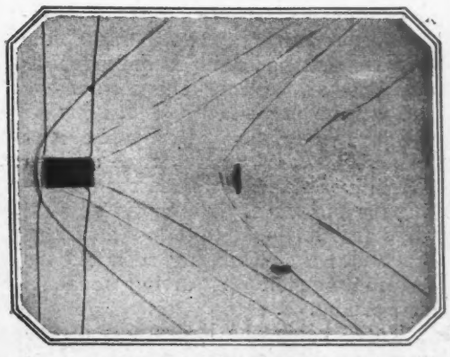
Danger of Oscillation

Similarly, a building may be perfectly safe for ordinary use, and its floors able to support the weight of heavy machinery; yet this same building might be thrown into violent vibrations if its natural period of oscillation should happen to coincide with the rate of revolution of a motor installed within it. The same kind of effect is liable to occur and has to be guarded against in the design of electric installations. If the dimensions of the electric circuit happen to stand in a certain numerical relation, powerful surges are liable to arise, which would either burn out the conducting lines or else break through the insulation; the period of revolution of the dynamo, and hence the frequency of the alternating current, coincides with the natural period of oscillation of the circuit.

Perhaps the most familiar example of resonance, the one after which the phenomenon has been named, is that of a body set into vibration by sound waves striking upon it. If you lift all the dampers off the strings of a piano by pressing down the "loud pedal," and sing any note of the musical scale into the body of the instrument, after the sound of your voice has died out you will hear certain of the strings vibrating and giving out their note, namely those strings one of whose natural periods of vibrations coincides with the note you sang into the piano.

Waves in the water, waves in the air, waves in the earth—there we have at least something tangible. But waves in the empty space between the stars—how can that be? The question is hard to answer. Modern developments seem to indicate that our difficulties in answering it are psychological at least in part. Just as the ear is deaf to sounds outside a certain compass of frequency, so the human mind may be incompetent fully to grasp certain facts and relations of nature. Perhaps the human race will have to recast its conceptions of time and space before it is able to gather into the realm of understanding certain aspects of such phenomena as the journey of light from sun to earth. But this we know: that light does travel through what is for all ordinary purposes empty (airless) space, and, in fact, travels through such empty space with greater ease and at a higher speed than even through the most transparent glass. And we know, further, that in its travel light displays all the characteristics of a wave disturbance; that it travels through space with the perfectly definite velocity of 186,000 miles a second, identically the same as that of the electric waves employed in wireless telegraphy. It is one of the feats of the genius of Clerk Maxwell, that he predicted the existence of these waves on theoretical grounds alone long before they had ever been observed, and that he identified light with them.

The wave lengths of visible radiation, the "light" we see, range from about sixteen one millionths of an inch for violet rays to about thirty one millionths of an inch for red rays.



A brass bullet with a hole through the center was shot from a rifle and photographed in the act. The high velocity of the bullet did not permit much air to pass through the hole, and thus the front air wave does not differ from that of a flat-headed bullet. But the air that did pass through hit the vacuum at the base of the bullet and started a sound wave. The friction of the air along the sides of the bullet is seen

Where the Eye Fails

Just as there are sounds too "high" and too "low" for the human ear to perceive, so there is light "too violet" and "too red" for the eye to see. But the photographic plate still detects ultra-violet rays with a wave length of about four one millionths of an inch. On the other hand, though a body may not be hot enough to give out visible radiation (as at red or white heat), it may still be emitting "heat rays" perceptible to the hand or observable by means of special instruments. The wave length of these may be taken to extend to about twenty-four ten thousandths of an inch.

Above the ultra-violet waves the scale is continued in X-rays, with a wave length of about two one billionths of an inch. Below the infra-red waves comes a long series of electromagnetic waves produced experimentally and ranging from about one tenth of an inch to many thousands of feet in length.

Lastly, the earth being negatively charged, and revolving around the sun, which probably carries a positive electric charge, must send out an annual wave having the stupendous length of six million million miles!

Ready to Battle with the Deep

Clad in armor, the diver would defies pressure that crush an unprotected man to death

DOWN, down, down, the diver goes after sunken treasure. How deep? Can he reach the *Lusitania*, which lies in more than three hundred feet of water? Not with the present diving apparatus. He would be squeezed into a pulp by the relentless grip of the water.

How deep can a diver go? The record is somewhat more than three hundred feet in sheltered waters. Out in the open sea it would be difficult to descend one hundred feet. The billions of tons of shipping and cargo sunk by the Germans lie in depths of more than one hundred feet. They cannot be reached with the aid of the ordinary diver's dress.

After all, that follows from the very nature of the dress. It is but a combination rubber garment that covers the whole body from the neck down, except the hands, which protrude through elastic cuffs, water-tight at the wrists. To this flexible garment is bolted a windowed helmet to which air is pumped from above. Inflated as it is, the dress is as buoyant as a cockle-shell. To sink the diver like a stone and to keep him upright, the soles of his shoes are weighted, each with sixteen pounds of lead. In addition, eighty pounds of lead are distributed around his body. His equipment weighs about one hundred and seventy pounds. Add to that his own weight of one hundred and fifty, and the total comes to three hundred and twenty-five pounds. He is connected with the surface not only by the air-hose, but by a signal- or life-line in which telephone wires are usually embedded.

Air Within Resists Air Without

Don't suppose that air is pumped into the helmet simply for the diver to breathe. Without the air he could not descend as far as he does. It is the air pressure within the suit that resists the water pressure outside. That intense pressure must be nicely regulated, so that he will not be squeezed to death by the relentless water. The deeper he goes the greater is the pressure of the water and the greater must be the opposing pressure of the air. There is a limit to the air pressure that a man can endure. Hence there is a limit to the depth to which he can descend—about three hundred feet under the most favorable conditions.

© Underwood & Underwood

This elephantine diving armor is the invention of Charles H. Jackson. A descent of three hundred and sixty feet has been made in it. It is said to have all the faults as well as all the merits of its predecessors

But this is not the only limitation imposed by the ordinary diver's dress. A man who has gone down as far as three hundred feet may not be hauled up quickly like a fish at the end of a line. The pressure of the air has forced nitrogen into his blood; for nitrogen constitutes about 80 per cent. of the air we breathe. That nitrogen must be released very gradually. The man's blood-vessels are like a corked bottle of soda-water. You know what happens when the cork is suddenly removed; you know that bubbles shoot up.

So it is with the diver. The nitrogen in his blood would bubble off if he were quickly pulled up. The result might be instant death—certainly suffering and a case of the disease that has come to be known as the "bends." The longer he stays below, the more highly charged with nitrogen does his blood become, and the longer must be the time allowed for him to rise. If he has been working for an hour at a depth of two hundred feet it would take four hours to haul him up. Only by such tedious "decompression" is diving made a safe calling.

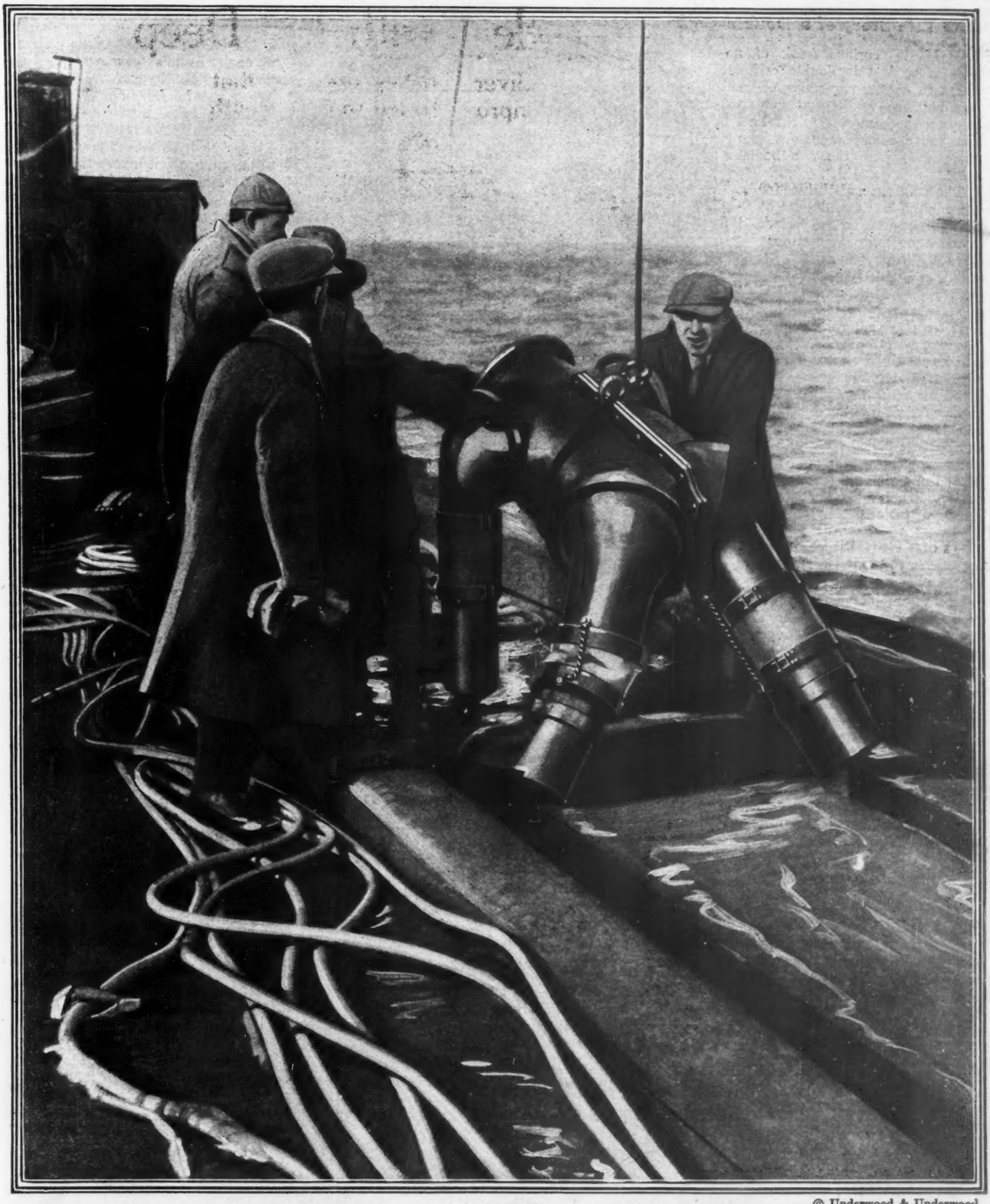
These being the limitations of the ordinary diver's dress, why not construct a metal suit, a rigid suit of plate mail, so strong that it would in itself resist the crushing force of water beyond three hundred feet? Let the man breathe air in ordinary atmospheric pressure,—the kind that you are breathing now,—no matter what his depth may be. Wouldn't that solve the problem? Wouldn't that enable him to come up to the surface at once without fear of having his blood boil in the effort to rid himself of its nitrogen? Wouldn't that make it possible to go down five hundred, six hundred, even one thousand feet, and reach hulks that seem now hopelessly inaccessible?

A Negro Mechanic's Invention

Long before Germany began to sink ships by the score, inventors had tried to realize this idea. The latest of these is Charles H. Jackson, a negro mechanic. A descent of three hundred and sixty feet has actually been made with his suit. Will it mean a fortune to its inventor, and the recovery of untold wealth that now lies at the bottom of the sea?

Anyone who is familiar with the past history of diving armor will tell you that there is little originality in Jackson's suit. It has all the faults and all the merits of its predecessors. Encased in such a rigid shell, a man cannot climb down a ladder, seize a rope, and lower himself, after the traditional manner of divers. A derrick must actually pick him up and drop him overboard. Jackson's suit, for example, weighs four hundred pounds, and that is light compared with others that have been experimented with. Depths of even six hundred feet have been attained with similar armor. No difficulty in breathing is experienced. But the man within the steel shell has no freedom of movement. He looks like some elephantine creature from another world. He moves about clumsily. His arms are encased in steel, and so are his hands. They must be so protected; for the terrific pressure of the water would crush his fingers into a shapeless mass. Hence, Jackson, like other inventors, employs an artificial hand—a mechanically operated iron claw.

Salvage experts reject all these diving suits—reject them because the joints leak at moderate depths and become tight only when the great water pressure at three hundred feet or more compresses them. Indeed, some inventors actually install automatic pumps in the suit to remove the water that seeps in. The most that can be expected of a man in such a cumbrous apparatus is to locate a wreck and possibly to guide an electric lifting magnet to steel billets or a clam-shell bucket to a pile of loose cargo.



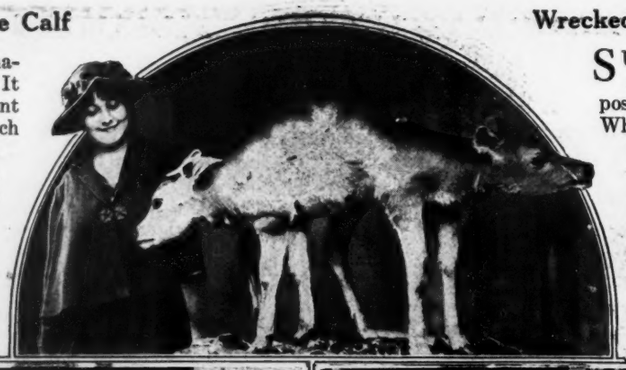
© Underwood & Underwood

As Helpless as a Fish Out of Water

Untold riches lie in the depths. Can the diver reach them? All depends on the armor. For this modern knight, if he is to secure the treasure, must meet and conquer the dragon of the great depths—crushing, deadly water pressure. That is why he is clad in steel armor so heavy that a derrick is needed to lift him from the deck of the ship and lower him over the side. If he were clad in the ordinary diving dress it would be necessary to fight back the killing pressure of the water by opposing to it the pressure of air forced into the suit by powerful pumps. But there is a limit to the amount of air pressure a man can endure: that limit is approximately the pressure required to fight back the water at a depth of three hundred feet. If men are to explore the greater deeps they must go down clad in armor in itself strong enough to defy the tremendous water pressure, leaving the diver free to breathe air at ordinary surface pressure while he works. Such a suit, the one shown in the reproduction of a photograph above, has been invented by a negro mechanic. A descent of three hundred and sixty feet has actually been made with it.

The diver is ready to adventure in the deeps. The heavy armor will save him from the crushing pressure of the water, but can he do useful salvage work encumbered by this shell of steel?

The Life Story of a Double Calf



A MOST curious freak of nature is this double calf. It has two heads, two pairs of front legs, and two bodies that join each other in an almost straight line. One pair of hind legs jut out from the point where the two bodies meet.

The calf lived and thrived for six months, but then it caught cold and died. The two perfect heads were quite independent of each other. The calf could eat with one or both at the same time, to suit itself.

It was born on a farm near Dayton, Ohio, and its parents were Jerseys. Although it was cared for most tenderly during its six months of life, it grew but little during that period.

As the lady above patted one of its heads, we wonder if the other head was jealous.

Wrecked Aviators Need Not Drown

SUPPOSE that your airship engine stalls over water. Suppose that the hydrogen is depleted. What then? The answer is to be found in a novel life-boat constructed of waterproof fabric, and designed to be inflated by the air-pumps which keep the envelope of a "blimp" rigid in spite of changes in gas volume. On ships of the Zeppelin type such as the R-34 the device is blown up by other means.

When inflated the airship life-boat will support six people until a rescue vessel summoned by the wireless of the wrecked airship comes to the rescue.

Our illustration gives an excellent idea of its general characteristics, though in this case the air-pumps are replaced by a much more attractive kind of inflater.

You Can Have Your Own Gasoline Station

AN automobile owner at Redondo Beach, Cal., became very tired of driving his car around to the garage every little while in order to replenish it with gasoline. Accordingly he had a tank built into the wall at the side of his driveway. You can see it in the above picture.

The tank is of metal, covered with cement. A connection is provided for filling and a float gage shows the amount of gasoline in the tank. To draw off the contents a small pump is used.

The owner has an arrangement with the gasoline distributors to keep the tank filled, and so he has a constant supply.

A Carving of General Pershing Made Out of Soap

THEY'VE photographed General Pershing, made busts of him, painted pictures of him, and now one man has carved his head out of soap!

This may seem queer to you, but if you were a soap salesman, or in fact any other kind of salesman, you would realize the value gained by decorating your product with a likeness of the hero of the hour.

The man who ordered the soap bust of Pershing was a druggist who, like most druggists, sold everything else besides drugs. He filled one window of his store with cakes of soap, placed the soap bust of Pershing in front, and thereby greatly increased his sales.

A Fence that Was Founded in Barrels

"WELL, I hate to take up all those paving-stones, and we certainly can't break through them to make post holes," said the boss, when he and the foreman were discussing the erection of a temporary fence over a portion of a sidewalk.

"M-m, no," replied the foreman; "but wait, I've got an idea: why not put the posts in barrels and then fill the barrels with something?"

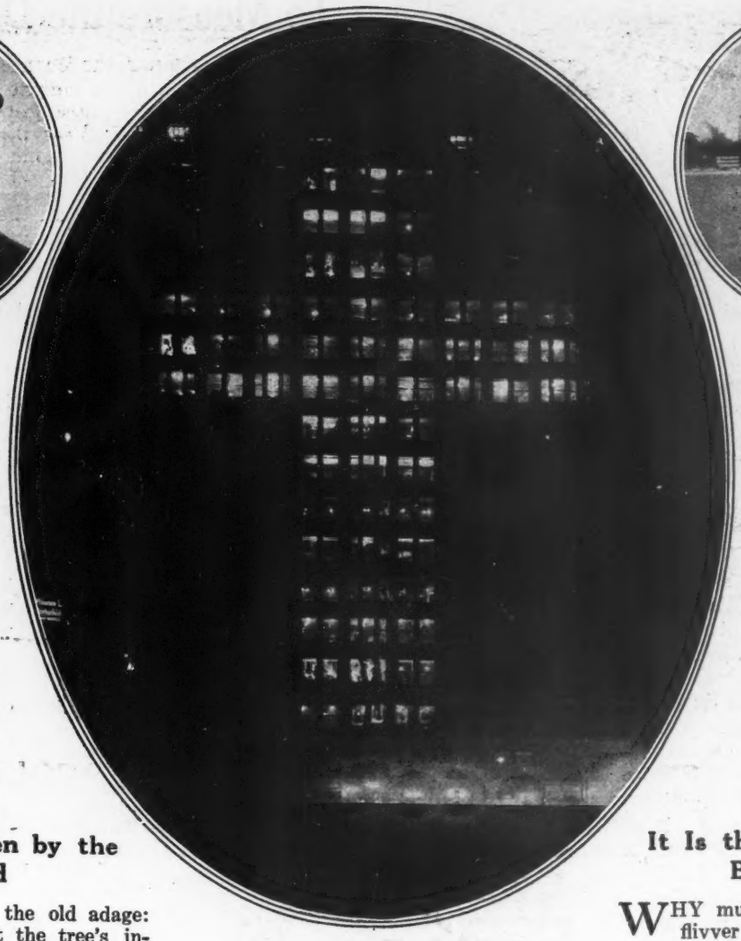
Accordingly the posts that were to support the fence—and a scaffolding later on—were placed in large tubs which were set out at equal distances along the line of the proposed fence. Ashes were brought from the boiler-room of the factory and the barrels were filled up, holding the posts firmly in place.

When a high slat fence was built on the posts in the ordinary way it afforded perfect protection against intruders. How it looked, inside and out, when it was finished you can see by a glance at the picture.

Billiards on a Cigar-Holder

WHEN Mr. Asra, a famous German billiard-player, gets through with the cigar-holder he is using it will undoubtedly find its way into the museum for freak works of art where the gem of the collection is a copy of the Venus de Milo with a clock in her abdomen.

The cigar-holder is six inches long and on it is mounted a small ivory billiard-table at which two men are playing.



Drinking at the Fire Hydrant

THE fire hydrants in the town of Torrance, Cal., have great white porcelain bowls erected on their tops. And when there are no fires in town the natives gather around these pumps and drink. For the bowls are regular drinking bowls into which a constant flow of water is forced.

To install one, a hole is drilled in the top of the cap of the hydrant and a one-inch pipe is connected with the water-pipe below.

Bent But Not Broken by the Wild Wind

HERE is new proof of the old adage: "As the twig is bent the tree's inclined."

Instead of growing straight upward the tree shown in the picture below grew horizontally after the trunk had attained a height of four feet. The reason for its L formation is the wind.

This tree is situated on an exposed part of a cliff in the Isle of Thanet, England. Ever since it started to grow the sea wind has blown on it from one direction. The tree was not strong enough to stand up against this constant force and so it bent over. In spite of this, the leaves are all doing well, nevertheless.

It often happens that plants and trees incline toward the light when they are located in dark places, but it is seldom that a tree bends over so completely because of the wind.

A Building Lit Up in the Shape of a Cross

SHOULD you approach the Railway Exchange Building in Chicago on a dark and gloomy night, don't be alarmed if you see from a distance a great brilliant cross standing out in front of the building. As you draw near you will see that it is simply the effect of certain lighted rooms against the dark background of the building.

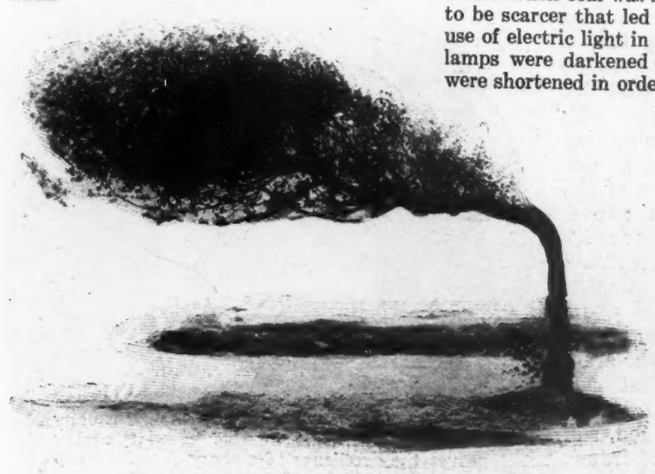
Many of the large office buildings in the Loop district of Chicago have gone in for this artistic illumination. They choose their designs and then light up the rooms necessary for making them.

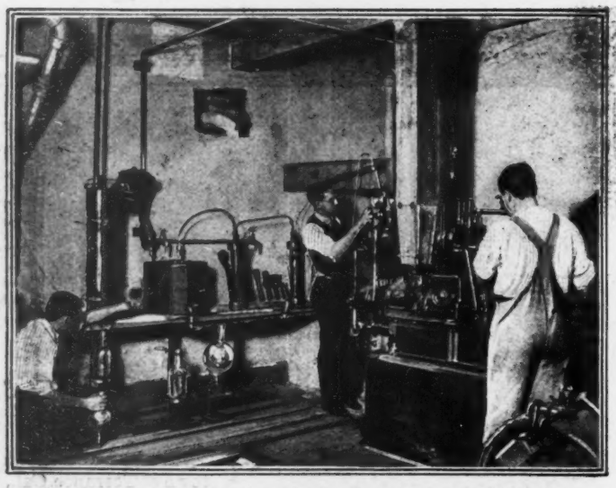
Perhaps it was this very extravagance at a time when coal was scarce and threatened to be scarcer that led to restriction in the use of electric light in Chicago. The street lamps were darkened and the office hours were shortened in order to save coal.

It Is the Limousine of the Bicycle World

WHY must a cyclist sit up straight, flivver fashion, when he rides? An uncomfortable Parisian cyclist asked himself this question, and answered it by building the bicycle shown below. It contains most of the comforts of an automobile driver's outfit. The seat itself is low and has a supporting back; instead of handle-bars there is a steering wheel with a horn mounted on it. The pedals are not directly below the seat but are up near the front wheel.

This front wheel, by the way, is smaller than the usual bicycle wheel, the reason for this being to make room for the long sloping steering wheel. Whether it is just as easy to pedal and keep your balance on a bicycle built like this one we know not.





At the right, compressing air; in the center, admitting it to the cooling tubes; at the left, drawing off liquid air

Making Liquid Air

AIR is invisible, says Webster's dictionary. Not always. Air can be turned into a liquid, whereupon it becomes quite visible. First, the air is compressed to three thousand pounds per square inch, which is about two hundred times as great as ordinary atmospheric pressure. Then it is cooled off in tubes until its temperature reaches three hundred and ten degrees, Fahrenheit, below zero. At this point it becomes a liquid.

Liquid air is used both in scientific research and in industry. In research work it is used for cooling; the substance is immersed in the liquid air and watched to see how it acts at low temperature. In industry liquid air is used to produce pure oxygen. Air is composed chiefly of oxygen and nitrogen, and owing to the different boiling points when liquefied they can be separated.

The Price of a Zeppelin Ride

THE value of the German mark sinks lower and lower. You can buy about forty of them for an American dollar now. Thus should you buy a dollar's worth and go to Germany, they would be worth nearly ten dollars over there, and you could buy ten dollars' worth of goods with them.

The Swiss, living next door to Germany, take advantage of this depreciation in mark value. A regular Zeppelin service from the Swiss border to Berlin has been running now for several months. The Swiss buy their tickets with German marks and thus the trip becomes a very cheap one. The Zeppelin makes the trip three times each week and it is always well patronized. This is due not only to the low value of the mark but also to the poor condition of the railways in Germany today.

Still, the owners of the Zeppelin are making money by it. They figure that in the first two years they will take in enough money to pay for the Zeppelin and then have a twenty-five per cent profit left over. So far no repair work has been necessary.

To Measure the Depth of a Well

AN ingenious apparatus for measuring the depth of wells or mine shafts is a dial indicator actuated by a worm gear, the invention of Charles A. Wilkins of Bradford, Pa. This measuring device contains two grooved wheels several inches apart and revolving in the same plane. One of these wheels is an idler, while the other is connected with the measuring mechanism by a worm gear which sets in motion the geared wheels of the two indicating dials, one of which registers up to one hundred, the other up to six thousand feet.

Place the grooved wheels against the cable, let the cable run up or down as far as it will go, and read off the distance on the dial

The rope or cable is placed against the two grooved wheels in the manner shown in the picture, so that it is pressed with considerable force against the lower wheel. As the cable moves up or down it makes the wheels go round. The rotations of the measuring wheel are communicated to the indicator, which shows with great accuracy the number of feet of rope or cable which have passed over the wheels.

Look Out, Below!

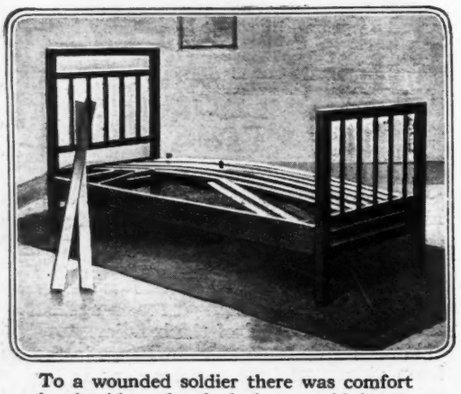
A SHARP blow on the back of the head with a heavy lead pipe—that ought to knock out anyone no matter how thick-skulled he may be; and yet the man in the picture below doesn't seem to mind it in the least.

Why not? He wears a shock-absorbing cap sufficiently thick and resilient to absorb most of the force of the blow. It has many air holes, so that the hair of the wearer is well ventilated.

The cap was not designed for men who walk down lonesome alleys on dark nights, but for miners, builders, tunnel-diggers, and others who are constantly in danger of having something heavy dropped on their heads.

The shock-absorbing cushion is circular in form and fits inside the cap.

A blow on the head with a lead pipe usually means trouble, but in this case it simply proves the excellence of a shock-absorbing cap



To a wounded soldier there was comfort in the idea of a bed that wouldn't sag

A Wooden Bed-Spring

WHILE lying wounded in a hospital, a French soldier named Delacourt found that his bed was developing hills and valleys from supporting his weight so long in one place. His solution of the problem is shown above.

Long springy slats are inserted tightly between head and foot boards, arching upward from the ends, every slat above having a companion slat below arching downward so that each pair forms an oval. A second set, similarly arranged, run crosswise of the bed-frame.

Learning to Walk All Over Again

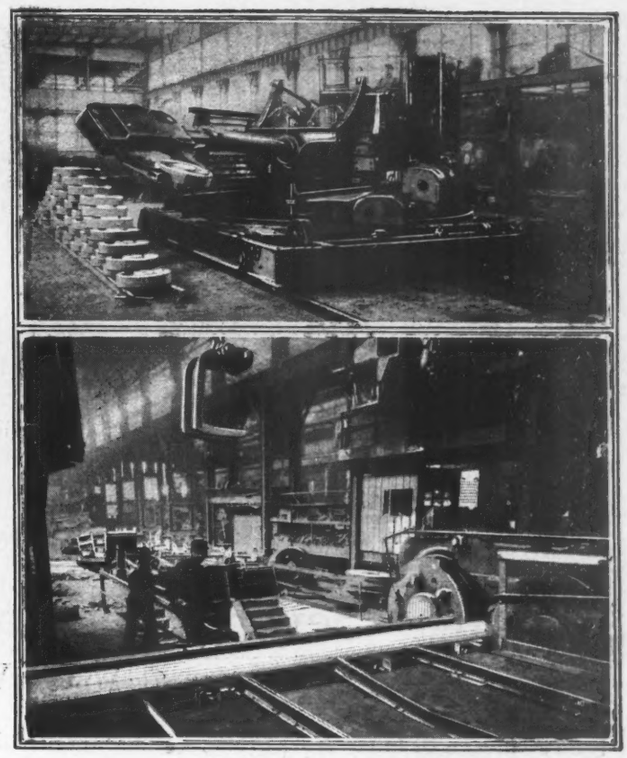
AFTER a long illness a patient usually has to learn to walk all over again.

How is this best done? Formerly the convalescent leaned on his doctors and nurses; but doctors and nurses are scarce in these days and their time should not be wasted in this fashion.

He's learning to walk for the second time; when he gets tired he can pull out the seat and sit down

Here is a chair that has been invented for the purpose of teaching grown-ups to walk. The seat is mounted on the white iron frame so that the patient may push it out of the way when he wishes to walk. He then grips the upper rails for support.

The chair moves on broad-flanged rollers, making it possible for the convalescent to push it around the room with very little effort or danger of fatigue.



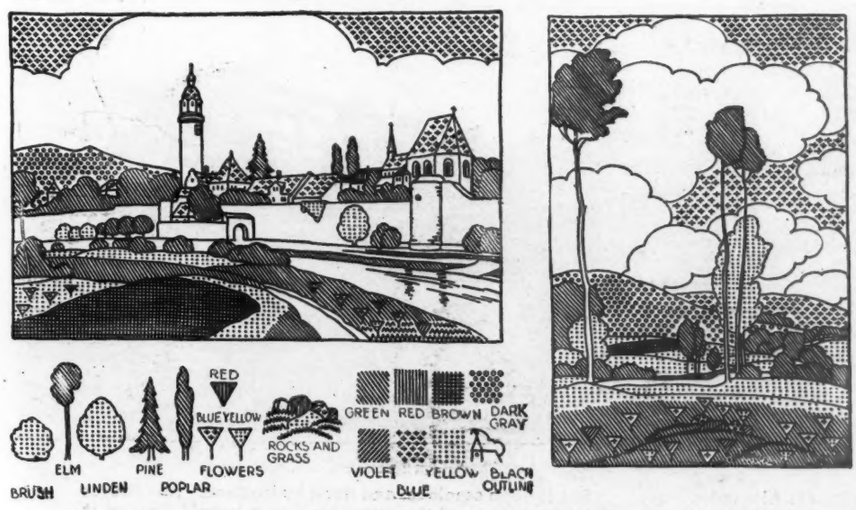
A pair of giant tongs picks up the finished wheels, as shown in the upper picture, and stacks them for shipment. In the lower picture blank car wheels are being sliced from a red-hot cylinder of steel by powerful rotary shears

Helping the Blind to "See" Color

FINGER-TIPS are the eyes of the blind. They cannot "see" beyond the reach of the hand, and notwithstanding the best of training can get impressions only of size, form, and surface texture, but never of color, distance, and perspective.

The invention of printing books with raised letters was a great blessing for the unfortunate thousands deprived of sight. The invention of the dot alphabet by Braille and its later improvement were of material help in making the storehouse of human knowledge accessible to the blind. Libraries were established and made available for their use where they could find books on various scientific subjects, on history, literature, and music, books of poetry, fiction, and travel.

And recently, under the stimulus of his sympathy for the thousands of soldiers who have become blind during the great war, Fried Stern, a German artist living at Frankfurt, has invented a method for conveying color impressions to the blind through their sense of touch. The pictures below illustrate the method employed. They are printed in relief on heavy paper and the colors are indicated by giving the surfaces different texture. These differences are produced by a system of lines, dots, crosses, etc. Each pattern represents a certain color as explained in the key which accompanies each picture.



This shows a German artist's idea of making color "visible" to the blind. The color is made palpable by its peculiar texture as indicated by the key

Slicing Off Steel Car Wheels

THE next time you cut a slice of bread, think of car wheels made of steel.

Why? Because in some factories wheels are sliced from a great round steel bar just as if it were a loaf of bread.

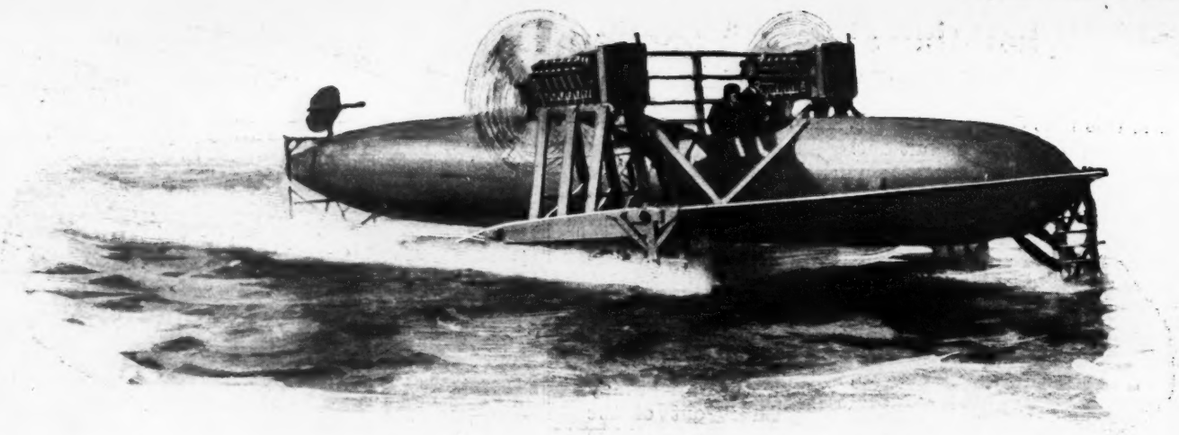
The first step in this new process is to roll a steel ingot into cylindrical shape, the cylinder having a diameter slightly less than the diameter of the wheel to be made. While the ingot is still hot the wheels are cut off to the proper thickness by a pair of powerful rotary shears.

The blank wheels are then heated, further, in a furnace; when hot, holes are punched through the centers, after which the wheels are fed one by one to a mill. Here they are whipped into shape by a pair of dies that are actuated by a hydraulic press.

The edges are trimmed off by shears and the wheel is finished. A giant pair of tongs seizes the finished wheels and stacks them up in piles on the floor.

The entire operation is completed in less than a minute and it takes but one attendant to work the machinery.

Owing to the continual growth in size of both freight and passenger cars, there is little doubt that the steel wheel is gradually supplanting wheels made of cast iron.



When at rest the HD-4 is supported by the hull and two outrigger hulls or pontoons connected with the main hull by means of a deck shaped like the wing of an airplane, and therefore made to work its passage. Steering is accomplished by turning the tail set of hydrofoils on a vertical axle

Seventy Miles an Hour on Water

By William Washburn Nutting

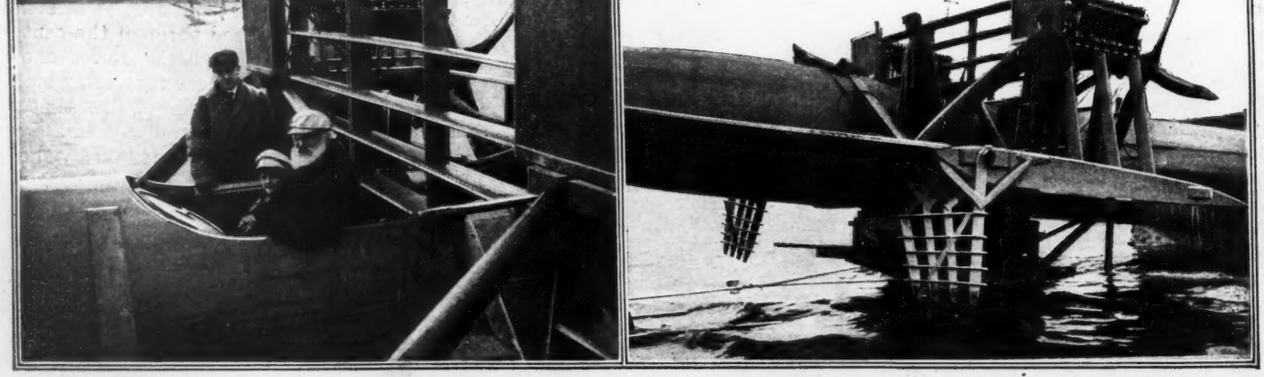
A STRANGE new craft, unlike anything thus far developed for air or water navigation, made its appearance recently on the Bras d'Or Lakes, Nova Scotia, where Dr. Graham Bell, inventor of the telephone, has his laboratories. The new glider, which has been startling the natives of Baddeck by tearing about the lake at the rate of seventy miles an hour, was developed from a series of experiments conducted by Mr. F. W. Baldwin and Dr. Bell during the past ten years. She is the fourth full-sized hydrodrome to be built. Hence the name—HD-4.

The new craft is not a seaplane; neither is she a hydroplane in the usual sense of the term. She is the successful application of the principle of dodging the resistance of the water by lifting the hull clear of it on a system of planes not a part of the hull itself. Many have been the attempts to work out a successful application of the idea on paper, as the patent office records will show. Cooper Hewitt and the Italian Forlanini both attained a degree of success with gliding craft using superposed planes several years ago. But the HD-4 is the first really successful embodiment of the idea.

At high speed the hull of the craft is entirely clear of the water, and is supported on small steel planes arranged in groups like the shutters of a Venetian blind. There are three of these sets, one on each side forward and one at the stern, giving a three-point support like that of an iceboat. A fourth set at the bow, called the "preventer" set, is used merely to assist the hull in climbing out when getting under way, and to prevent the bow from diving when traveling in rough water.

The faster the boat goes, the higher she rises from the water, so that she automatically reduces or reefs the submerged hydrofoil surface to just the amount required to carry the load. This reefing principle is one of the important features of the HD-4. Some day it may be applied to an airplane to reduce the wing area when traveling at full speed and hence increase efficiency.

In spite of the fact that the HD-4 weighs more than ten thousand pounds, she is supported on less than four square feet of submerged hydrofoil surface when at sixty knots, which means that every square foot is lifting more than two thousand pounds. When you consider the fact that an airplane wing supports about ten pounds to the square foot, this seems unbelievable, until you remember that the areas of the supporting surfaces are in inverse proportion to the specific gravities of the mediums in which they act. Salt water is nearly eight hundred times as heavy as air, which explains the fact that the hydrofoil surface need be but $\frac{1}{800}$ of the area of the wings of an airplane to support the same load.



© International Film Service

The gentleman who looks like Santa Claus is Alexander Graham Bell, the inventor of the telephone. He has now devised a boat which lifts itself out of the water just as an airplane lifts itself up off the ground

She is not a seaplane, and not a hydroplane. She dodges the resistance of the water by lifting herself clear of it on a system of planes not a part of the hull itself. Her speed is seventy miles an hour. The HD-4 is sixty feet long

What the Handy Man Can Do with an Old House

By George M. Petersen

This article is published with the idea of offering assistance to those of our readers who want to keep their property up-to-date. Any questions that may arise in the reader's mind will cheerfully be answered by the author free of charge, if a letter is forwarded care of the POPULAR SCIENCE MONTHLY *with a stamped envelope enclosed for reply.*—EDITOR.

IT is undoubtedly true that many American houses are as the first occupants left them, because the owners are living in the hope that some day in the dim future they may be able to build a bigger and better one, and are consequently loath to expend any money on remodeling the one they now have. This is a mistaken and foolish idea for various reasons. The old home can be remodeled satisfactorily without any great expenditure and will last for many years to come.

It is, therefore, with the idea of being of some real assistance to our readers who are progressive enough to want to keep their property up-to-date that we are publishing this article on remodeling.

SOLUTION NO. 4

Here the front part of the house has been altered, so that the two side chambers are greatly enlarged

The style of house that we have chosen for consideration is the old-fashioned one-story cottage, which is just as it was fifty years ago with the exception that the outhouse has been abolished and a toilet installed in a closet off of the kitchen. Of course this was really an improvement in some respects, but hardly one which can be considered to be really up-to-the-minute from a sanitary point of view. The plan with which we shall work is shown in the drawing captioned Original Plan (page 92).

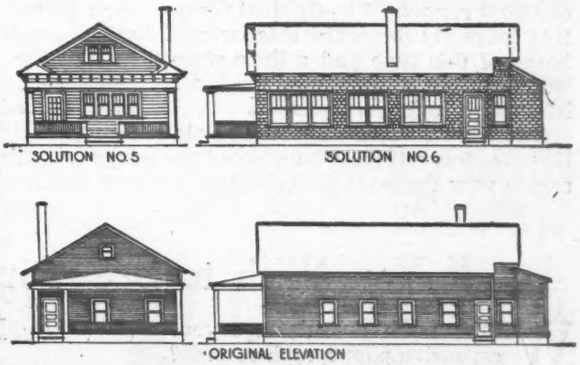
It will be noted that aside from the rather poor arrangement of rooms the rooms themselves are poorly lighted, a common fault with the typical old house of this type. In this regard it may be well to mention that no matter what else you do when remodeling your house do not fail to get sufficient light and ventilation.

In Solution No. 1 we have modernized the house, to a certain extent at least, by merely moving the old pantry partitions and building in a bath-room which is easily reached from either of the two bedrooms. Although this step does not appear to be very drastic it is really very important, as for very small expense the property has been made fully one hundred per cent more desirable.

Solution No 2 has proceeded another step in the right direction and the partition between the reception hall and parlor has been removed so that a large modern living-room has been obtained. This move is especially desirable because it gives one the impression that the house is an up-to-date bungalow instead of an old house remodeled. The back parlor has given way to the dining-room, while the old dining-room has been partitioned off into a hall and office. This is really an excellent solution of the problem which confronts so many persons today—how to have an office right in the home which will look businesslike without going to excessive expense.

Solution No. 3 has gone another step in the right direction and brought the kitchen location into juxtaposition with the dining-room. This latter room has been made a trifle narrower and a little longer in order that clothes closets, linen closet, and hall may be incorporated into the scheme. Here, again, the young professional or business man may have his office without in any way interfering with the home section of the house. If an office is not required the room may be used as a den, or it will make another excellent bed-room so that the house will then possess three chambers.

Solution No. 4 leaves the entire rear part of the house just as it was in Solution No. 3, but the front part has been altered so that the two side chambers are greatly enlarged. Of course the living-room suffered a little in size as the result of this move, but this fault, if it may be so termed, is readily overcome by the legitimate use of a large-cased opening between the living-room and the dining-room, which allows them to be thrown together as practically one room if a large party is expected.

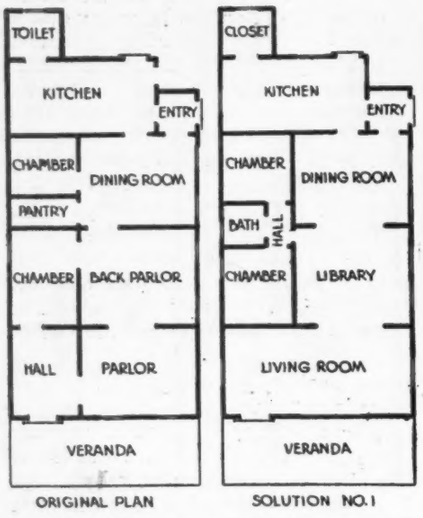


Above, the house covered with narrow siding; below, the same house covered with shingles

This is the same idea as the one shown in Solution No. 3. One may consider the living-room and dining-room as two rooms, though in reality they are only one. In this instance the idea was to convert the space across the front of the house into a music-room and a living-room by just showing the suggestion of a partition between them. This cased opening problem is worthy of considerable thought upon the part of the owner, as it is often easier to furnish two rooms than it is to furnish one large one.

Of course, any of these plans or

solutions may be carried further by the addition of a fireplace in the living- or dining-rooms. Hardwood floors throughout the house, built-in book-cases, china cabinets, kitchen dressers, linen closets, and many other features of a like nature will greatly add to the beauty and comfort of your remodeled house, but such things are not actually essential and may be put in at any time without any great additional expense.



Remove the old pantry partitions and build in a bath-room opening conveniently into the two bedrooms

Of course the remodeling need not end with the interior, but may be continued to the exterior as well with excellent results. The Original Elevation (page 91) shows the exterior of a house of this type and a little study will convince anyone how readily it lends itself to modern ideas.

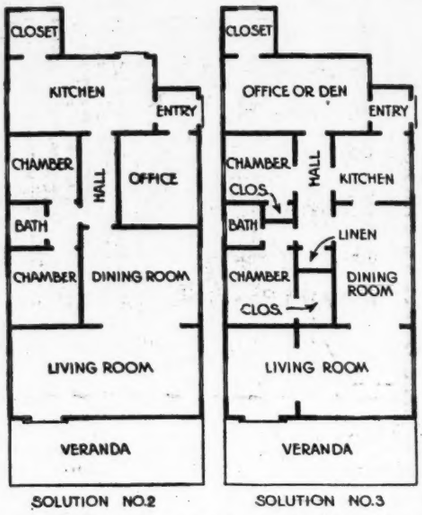
The front elevation shown in Solution No. 5 is a typical bungalow type and is very desirable for this style of house. This alteration is especially adapted to the plan shown in Solution No. 2, although it would look well with almost any window layout. The plain gable cornice has been replaced by a very wide barge board and heavy moldings, and the main cornice has been carried across the front of the house. This cornice is supported by medium weight brackets and the whole tendency of the elevation is to make the building appear heavy, solid and massive.

The small balusters shown in the veranda rail on the old elevation have been replaced with one and three quarter inch square pickets which are placed between heavy top and bottom rails. The veranda columns and newels are slightly tapered, instead of being perfectly straight as in the old elevation and the pitch of the roof has been altered so that it is now sloped toward the front of the house to allow for the cornice return across the front of the building.

The small window in Solution No. 5 also helps to set off the house, but casement windows are not recommended by the writer. Use double hung or check sash windows, as they are commonly termed, and reduce the size of the glass in order to get them into a given opening rather than install the larger glass and a casement sash.

The main reason for this statement is the fact that it is almost impossible to make casement windows tight unless a comparatively large amount of money is expended upon each individual window for patented weather-strip, and then the results are usually far from satisfactory. It is therefore best to stick to the double hung windows and cut the upper sash into three lights as shown in the drawings or some other design which will suit the artistic ideas of the owner.

The side elevation shown in Solution No. 6 is of the same house covered with shingles, instead of the old narrow siding, and was designed to work with the plan shown in Solution No. 4. This side elevation allows a great quantity of light and ventilation in the house and, as has already been mentioned, too much of either of these items cannot be obtained. In this elevation the gable is shown supported on five heavy brackets, while the main roof cornice is blocked up on lookouts.



By a little planning, the reception hall and parlor may be transformed into a large living-room

It is certainly a fact that building materials are high priced at present but that is all the more reason why people should do their building and remodeling now instead of waiting for prices to come down, as all material is going up, not down, and there is little doubt but that it will remain up at its present price, or even higher, for some time to come.

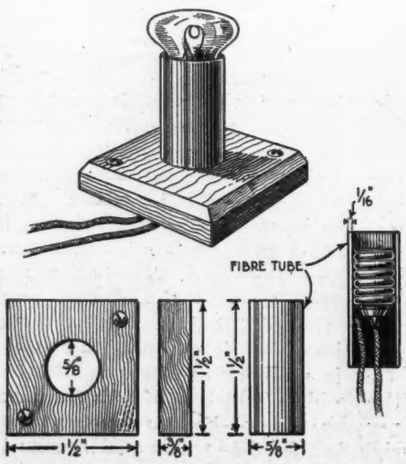
If You Wish to See Your Phonograph Records at Night

By H. E. Mende

WHY scratch and damage your expensive phonograph records? You can install a miniature electric light in a very few minutes, so placed that it will illuminate the record while at the same time leaving the room in darkness.

Obtain a piece of hardwood and cut a piece from it ⅜ by 1½ by 1½ in. Drill a hole in the center ⅝ in. in diameter, also two small holes in each side, to be used for screwing it to the motor-board; then bevel the edges. Now get a piece of fiber tubing ⅝ in. in diameter with 1/16 in. wall and 1½ in. long. This piece is to be glued into the ⅝-in. hole in the center of the base.

Purchase a keyless receptacle for the miniature screw base bulb, and break loose the cement to take out the brass threaded sleeve and the bottom screw; then solder a piece of thin insulated wire to the brass thread sleeve and one also to the bottom screw.



This illustration shows the entire mechanism before and after assembling

Now the parts are ready to be assembled in the fiber tubing, which must be fastened in place with plaster-of-paris. Be very careful not to have these two parts of the wires touch, since that would, of course, cause a short circuit.

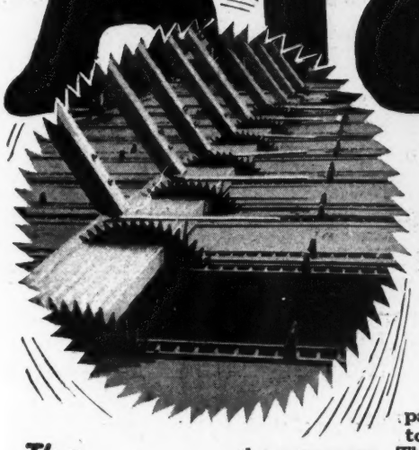
The light is now finished. The next thing to do is to determine the best place to install the light, where it will not interfere with the working parts of the phonograph. When this is settled, drill a ⅛-in. hole through the motor-board, and screw the light in position. Place the batteries in the bottom of the machine and connect the wires.

The correct bulb for one battery is 1.5 volts. The bulb takes the place of a switch, which lights when it is screwed down and goes out when it is loosened.

Aladdin

Readi-Cut Homes

Cut Building Costs



Lumber shortage—a virtual famine of lumber—exists in many parts of the country. Reports indicate it is impossible even now to get material for certain needs. Stocks were never as low as they are now. The demand was never as great as it is now. THIS MEANS STILL HIGHER LUMBER PRICES. It means that prices will go upward rapidly—that it will possibly take $150 in six months or a year to buy $100 worth of lumber at present prices.

The System

Complete Material for Immediate Shipment

Aladdin taps the four greatest forests of the United States. Each one has sufficient standing timber to take care of the needs of the country for many years. The probable lumber famine predicted in all parts of the country will not affect the Aladdin Co.

Every Aladdin house ordered in 1920 will be shipped quickly and *completely*. Sufficient lath and plaster for lining the interior of the home. Nails in necessary sizes and quantities. Beautiful grain, perfect quality interior trim. Doors of high quality material and excellent workmanship. Every item of the complete home will be promptly shipped to every Aladdin purchaser in 1920, regardless of shortage of lumber and other building materials in the general markets.

National Homebuilding Service

Shipments of Aladdin Readi-cut Homes are made from the four greatest timber-producing sections in the United States. From the Atlantic to the Pacific—from Canada to the Gulf—Aladdin can serve you wherever you live. Aladdin houses are manufactured and shipped direct from the Aladdin Company's own mills in Michigan, Mississippi, North Carolina and Oregon. Aladdin houses come to you in a straight line from the nearest timber region. Complete Sales and Business Offices are maintained in connection with each mill. Fully 24 hours time is saved in your mail reaching our offices.

20 ft. of Lumber from a 16 ft. Board

The Aladdin System of Homebuilding has been practicing for 14 years the principle the world has only learned during the war—the elimination of waste of lumber and labor. The Aladdin Book explains this system thoroughly, shows how 20 feet of lumber is cut from a 16 ft. board. The great Aladdin Organization, composed of experts in every branch of homebuilding, stands ready to help you build your home at a saving. Put this group of experts to work on your problem.

Send for Interesting Book "Aladdin Homes"

The Aladdin Book of Homes has a message for you. Amongst its pages, profusely illustrated in colors, leading home designs are represented to you. Aladdin houses are cut-to-fit as follows: Lumber, millwork, flooring, outside and inside finish, doors, windows, shingles, lath and plaster, hardware, locks, nails, paints, varnishes. The material is shipped to you in a sealed box-car, complete, ready to erect. Safe arrival of the complete material in perfect condition is guaranteed. Send today for a copy of the book, "Aladdin Homes," No. 1372.

The Result

First Day's Work

Noon, Third Day

Seventh Day

Twentieth Day

The Aladdin Co.

Bay City, Mich.

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Enclosed find stamps for the book "Aladdin Homes" No. 1372.

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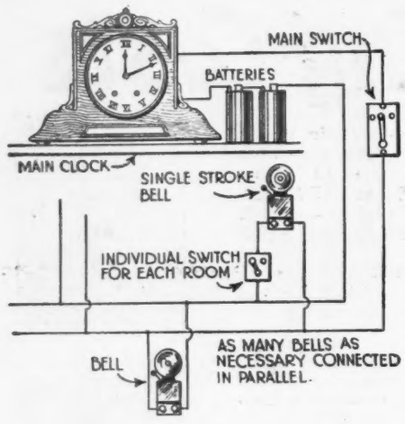
How to Make All the Clocks Strike at Once

By L. B. Robbins

IF you have ever lain awake in the night and listened to several clocks trying to strike in time with each other, with a syncopation which reminded you of a jazz band or an Oriental funeral procession, you will appreciate the following device to eliminate such ragtime and make Father Time walk the straight and narrow path. The idea consists of utilizing the best timekeeper in the house as the central station and electrically transferring the impulse of its strike to bells in the various rooms of the house. In this way the hour is struck by each bell at precisely the instant it is struck



The whole contrivance is operated by the master clock

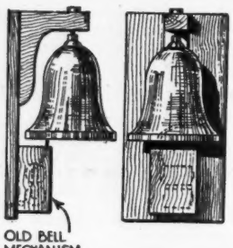
by that of the central clock, and there will be no guesswork as to the time.

The general arrangement is shown in the drawings with such detailed sketches as are necessary to make the operation plain.

The first requisite is a clock that strikes the hour and half hour. The style of striker is immaterial so long as it consists of a lever, pivoted somewhere along its length, one end of which connects with the striker wheel, the opposite end striking the gong. By studying the detailed sketch of the striking apparatus this will be clearly seen. Styles and shapes of levers may vary, but the principle remains the same.

Select a narrow strip of very thin, flexible metal, which will give under the slightest pressure but will return to its original shape when the pressure is removed. If the lever can be conveniently removed from its position in the clock, this piece of spring metal can be soldered to the lever close to the pivot hole. If not it can be clamped to the lever, in this position, with fine wire. The extending end should be doubled under, as shown, to gain greater flexibility. Bend it so that its relation with the side of the clock is about as indicated.

Directly under this spring place a block of wood, fiber, or rubber, into which a screw is inserted. The block serves to insulate the screw from the clock frame or any metal parts. Connect the screw to an insulated binding-post, at a convenient point, with insulated wire. Then bring the head of the screw to within a fraction of an inch of the spring strip. The distance should be adjusted so the strip will come into good contact with the screw when the hammer of the striker is in contact with the gong, but so that there is good clearance between them when the hammer is back at its resting-point.



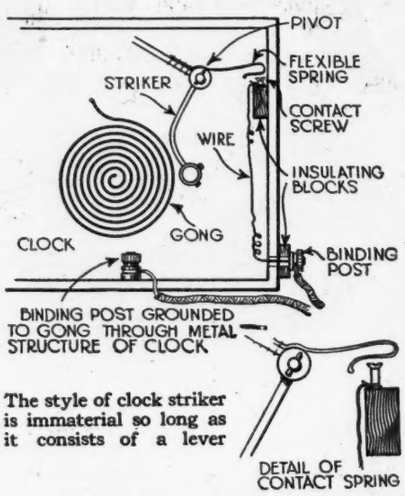
The bells can be made ornamental and the working parts hidden

A second binding-post should then be connected to the metal framework of the clock. Be sure this has metallic connection with the gong.

This completes the alterations to the clock.

Wire the house bells in parallel as shown. Provide each bell with an individual switch, so that it may be cut out if necessary. This, owing to the method of wiring, will not prevent the other bells from striking with the clock. A general switch near the clock serves to cut out the entire system if so desired.

Use bells with a single stroke action.



The style of clock striker is immaterial so long as it consists of a lever

These will give the best results as the time of contact of the gong switch is so brief that it would have little effect upon the vibrators of the bells.

If no single stroke bells can be readily procured common vibrator bells can be changed to single stroke action by disconnecting the wiring from the vibrator adjusting screw, and transferring it directly to the magnet windings by means of the off binding-post. Thus, when the coils are magnetized they pull the armature to them, but release it the instant the current is shut off. The spring at the foot of the armature serves to return the hammer to its former position.

If the builder wishes, he can make brackets to hold small bells of more conventional pattern, and utilize the magnets and equipment of call bells. The working parts can be hidden from sight by neat little boxes built around them. One's own ingenuity will suggest many artistic ways in which these striking bells can be disguised.

Handling Electrical Circuits in Safety

CARELESSNESS in handling electrical circuits is the cause of many fatalities. Electricity may endanger the life or seriously maim the person who works on live wires in a careless manner. Serious results may be the consequence of direct contact, causing burns, severe shock, and, in many cases, instant death. A flash or an arc may endanger the eyesight, besides being the cause of severe burns.

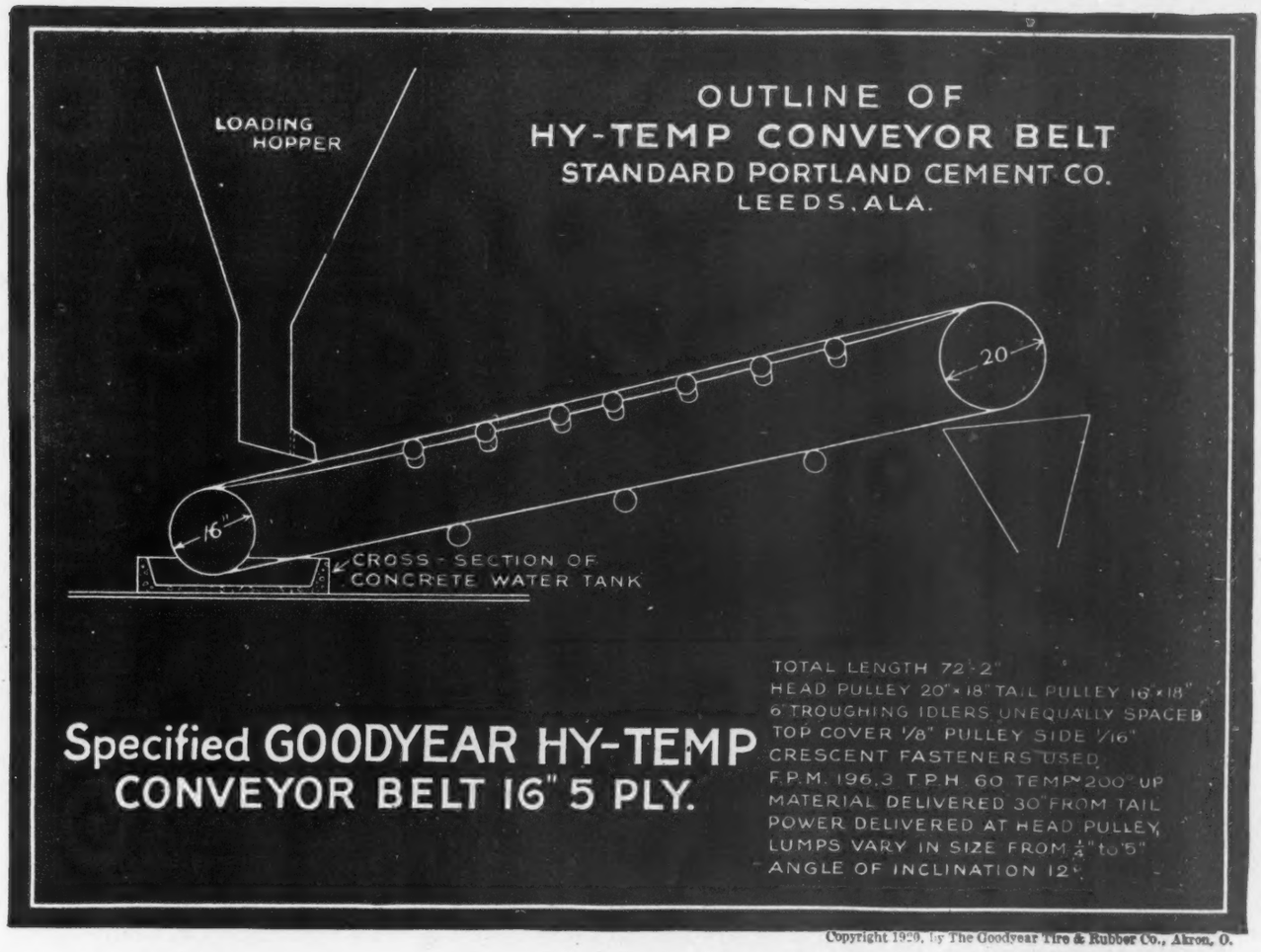
A shock is the result of touching wires of opposite polarity, or of cutting oneself into the circuit, or of touching a one-line wire and making a connection through the body to the ground. Provided one is perfectly insulated from the ground, he may safely touch one bare wire. A person should never trust a system of wiring, since a ground may come at any instant and endanger life. In handling live wires, the following rule is safe to follow:

Use only one hand at a time; keep well insulated from the ground, and from wires having opposite polarity.

The severity of a shock depends primarily upon the circuit voltage and the degree of contact made with the live wire. Contact varies with the condition of that part of the body that touches—whether dry or moist; and with the quality of the ground connection through the body. It is not always safe to touch a live wire of low potential, nor is it always fatal to make contact with a high-voltage circuit.

Danger to the eyesight and from burns is caused usually while fusing a circuit, or while throwing in or out switches on circuits carrying heavy currents. Carelessness in handling live-wire ends may cause a short-circuit and consequent injurious flashes.

Carrying too much current will cause wires to become overheated. Broken circuits cause an arc which may communicate fire.


LOADING HOPPER
OUTLINE OF
HY-TEMP CONVEYOR BELT
STANDARD PORTLAND CEMENT CO.
LEEDS, ALA.
20"
16"
CROSS - SECTION OF CONCRETE WATER TANK
Specified GOODYEAR HY-TEMP CONVEYOR BELT 16" 5 PLY.
TOTAL LENGTH 72'-2"
HEAD PULLEY 20"×18" TAIL PULLEY 16"×18"
6 TROUGHING IDLERS UNEQUALLY SPACED
TOP COVER 1/8" PULLEY SIDE 1/16"
CRESCENT FASTENERS USED
F.P.M. 196.3 T.P.H. 60 TEMP. 200° UP
MATERIAL DELIVERED 30" FROM TAIL
POWER DELIVERED AT HEAD PULLEY
LUMPS VARY IN SIZE FROM 1/4" to 5"
ANGLE OF INCLINATION 12°

Copyright 1920, by The Goodyear Tire & Rubber Co., Akron, O.

Hot Clinker, a Conveyor—and the G.T.M.

Hot cement clinkers, 200° and over, to be carried from open storage to the grinding mills, were the crux of the conveying problem put up by the plant superintendent to the G. T. M.

The G. T. M.—Goodyear Technical Man—gave that situation expert study embracing every process in cement manufacture at the plant of the Standard Portland Cement Co., Leeds, Ala. He realized that here was an unusual problem. The clinker could not be cooled sufficiently in the processes previous to conveying. The best thing to do would be to provide some means of cooling it as it came onto the belt.

So he made two recommendations: a heat-resistant Goodyear Hy-Temp Conveyor Belt, known to be capable of withstanding as much as 200°; and a cooling vat through which the belt might run as it struck the tail pulley and come up dripping with a film of cold water that would cool the clinker dropping from the hopper. Both recommendations were approved.

Up to September 1, 1919—after six months of operation—this Goodyear Hy-Temp Conveyor had carried 61,000 tons of clinker. The Standard Portland Cement Co. credits a saving of $300 in belt cost alone to this Goodyear Conveyor. Besides, it has effected a high operating economy. A letter from them states that the Company is "so pleased with its performance that we have ordered a duplicate for replacement, although from present appearances this belt will continue to give good service for some time."

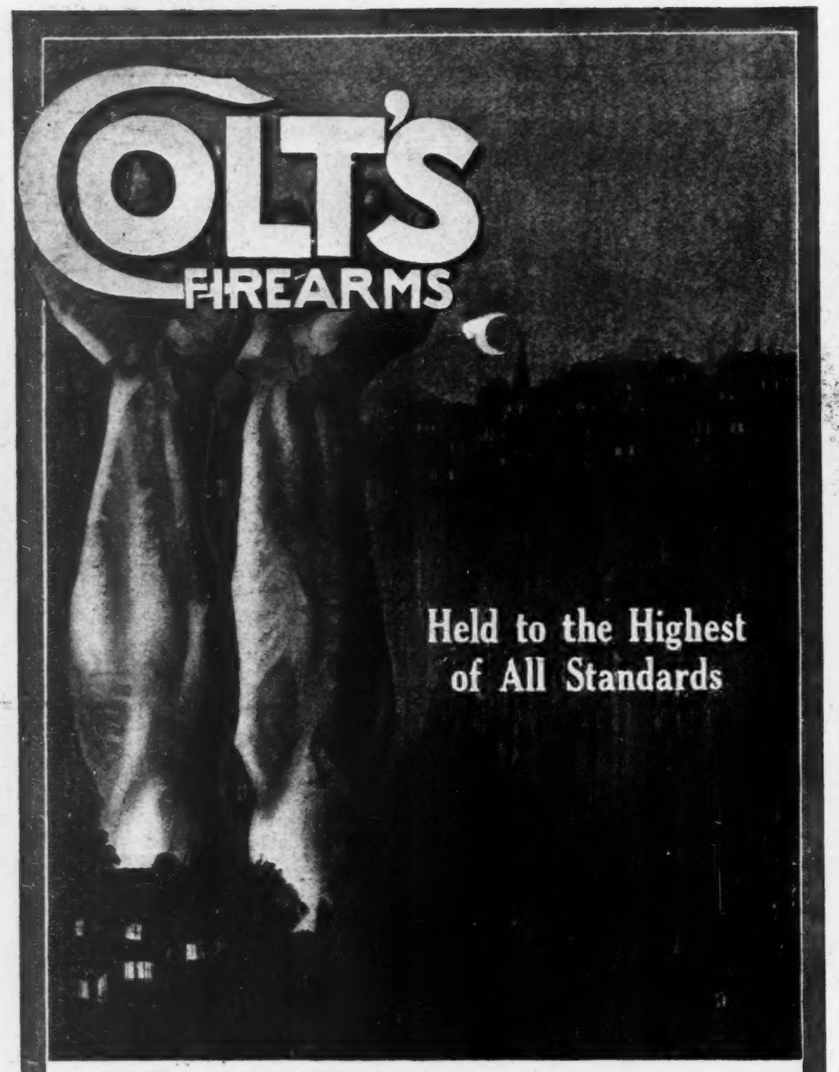
Wherever heats up to 200° are registered on conveying jobs, in mines, in coking plants, in cement factories, Goodyear Hy-Temp Conveyor's special construction sets up new records in heat-resistance, ability to withstand abrasion, and quantity of tonnage delivered.

Working with your own plant superintendent, the G. T. M. can make an analysis that assures intelligent specification of the belt to the duty required. The G. T. M.'s services are yours without charge or obligation. If his suggestions and the Goodyear Belt he recommends prove as valuable in your service as in the instance cited here, and in hundreds of similar cases the country over, our return will be amply guaranteed by your satisfaction.

THE GOODYEAR TIRE & RUBBER COMPANY
Offices Throughout the World

BELTING · PACKING · HOSE · VALVES

GOODYEAR



Master Craftsmanship

Your home needs this same *Colt* protection—the protection of "the world's *right arm*" For now that the *Colt* is back in Civilian Service you do not need to accept a "Second Best"

NO handiwork of man possesses a finer degree of mechanical exactness, a nicer precision of working parts, a more compact strength than the creation of the master gunsmith—
And to have maintained unquestioned leadership for over eighty years—keeping step with every advance of an inventive age—is the return made by the great *Colt* factories to a trust imposed by Government request.
Since its adoption in 1911, the *Colt* Automatic Pistol, caliber .45, has been the official side arm of our Army, Navy and Marine Corps and with them did its "bit" overseas

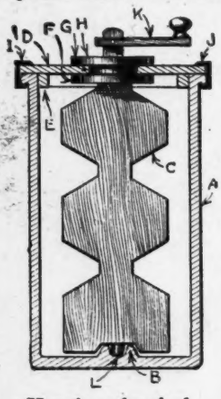
COLT'S PATENT FIRE ARMS MFG. CO.
HARTFORD, CONN., U. S. A
Manufacturers of

Colt's Revolvers
Colt's (Browning) Automatic Machine Guns
Colt's Automatic Pistols
Colt's (Browning) Automatic Machine Rifles

Trade Mark
Reg U S Pat. Off.

An Inexpensively Made Chemical-Mixer

A CERTAIN manufacturing company recently found it necessary to have a small capacity mixer for chemicals which would do away with metal parts as much as possible, the chemicals being of such a nature that they would eat the metal away. After some experimenting the difficulty was solved by the mixer here described.



Here is a chemical-mixer with parts made entirely of wood. Clamps hold the mixer in place

A ten-gallon crock, *A*, was purchased which had a cuplike receptacle, *B*, in the center of the bottom as shown in the illustration.

A wooden paddle, *C*, was made from wood cut from one piece. The cover, *D*, which had a flange, *E*, on the inside was made, and a revolving collar consisting of three pieces, *F*, *G*, *H*, nailed together, was fitted upon it. The cover with its collar was held firmly in place by clamps, *I* and *J*. The top of the paddle extended up through a hole in the revolving collar, and a crank and handle, *K*, was then fitted on. The bottom of the paddle was cut with a kind of round knob *L* which fitted into *B*.

When the crank was turned the paddle and collar revolved together, the cover acting as guide and holding everything in place with the clamps.—ALBERT E. JONES.

Make a Medicine-Dropper from the Stopper

OFTEN it is very necessary to measure medicine by drops, and not infrequently the medicine-dropper is mislaid or broken.

The cork medicine-dropper has advantages all its own, for it is a part of the bottle and the time saved over the old method of first filling, then expelling the liquid from the patent dropper, is considerable.

The cork stopper fitted in the medicine bottle is used. Cut a groove from the bottom to the top of the cork, about 1/8 in. deep and half as wide, then put the stopper back into the bottle.

If the stopper does not drip properly, take your jack-knife and deepen the groove still further. The exact size of the groove will depend somewhat on the quality of the cork, how tightly the stopper is fitted into the bottle, and the character of the liquid contents. Once having tried this method, you will not be likely to resort to the old.—J. T. BARTLETT.

How fast does a truck wear out?

If a truck were jacked up off the ground and the engine merely used to transmit power to some machine, it would take years to wear out the motor.

It isn't the running of a truck engine that wears it out. It's the pounding it gets from road shocks.

The life of a truck is very largely dependent upon the resiliency of the tires it rides on. Fleet-owners who have put Kelly Caterpillars on their trucks tell us that the trucks now spend their time on the road instead of in the repair shop.

The reason is simply that Kelly Caterpillars have an unusual depth of rubber and a system of side vents that doubles their resiliency.

Kelly-Springfield Tire Co.

GENERAL SALES DEPARTMENT

4614 Prospect Ave., Cleveland, O.

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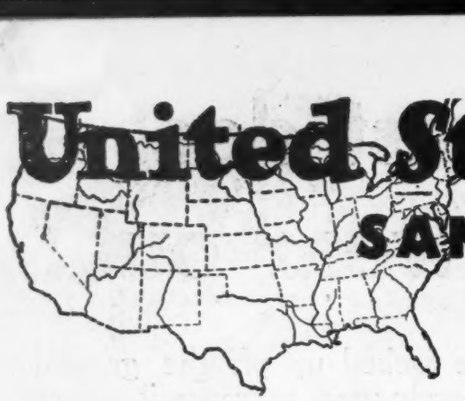
June 28, 1904
Aug. 31, 1915
Mar. 14, 1916
Feb. 19, 1918

KELLY SPRINGFIELD TRUCK TIRES



United States SAND PAPER

Fast-Cutting Mineral Abrasives
On cloth and paper
Flint Paper
Garnet Paper Garnet Cloth
Emery Paper Emery Cloth
Crocus Cloth
Carbalox Cloth
Herculundum Cloth
Sheets, Discs, Circles, Belts and Rolls of various widths and lengths of the above U. S. Abrasives.

Sand Paper is NOT made with sand

Sand is round; it will not cut. Sand paper is a *cutting tool.* Like other tools, it must have that which corresponds to temper; must hold a cutting edge.

Good sand paper is made by us from Nature's whitest flint rock or the reddest garnet, crushed, sifted to different finenesses and everlastingly glued to strong cloth or tough fibred paper especially made for the purpose. Other U. S. abrasives are from the fiery electric furnace; remarkably tough, and hard enough to cut metals: these are known as Herculundum and Carbalox. For cast iron and similar materials, Herculundum is ideal. Carbalox is best for steel, brass, copper, aluminum, etc.

A disc grinder using U. S. flint or garnet paper smooths wooden things up in a jiffy. Disc grinders are made in various sizes; horizontal and vertical types

In modern woodworking plants U. S. Sand Paper—flint and garnet—are used in sheets and convenient width rolls for fine hand finishing work. Here, actual *belts* of sand paper running at high speed, quickly whisk the roughness from irregular pieces. Rolls of sand paper on *drums* smooth up rough doors, sashes and other flat work. *Discs* of U. S. garnet paper on rapidly revolving wheels bite rough spots off quick as a wink.

In foundries and machine shops, discs of Carbalox and Herculundum are doing fine finishing work formerly handled by planers and milling machines at great saving of time and labor. Get all the facts on this.

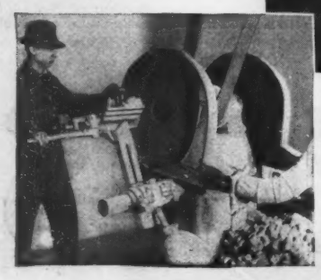
Everywhere, in all industries, the map trademark of the United States Sand Paper Co. is known as the mark of dependable abrasives—of quality that does not vary.

Buy your abrasive papers or cloth as you would fine tools. Our Service Department will study your requirements and recommend the grades best suited to your work. Tell us whether you work on wood, metal, leather or composition materials.

UNITED STATES SAND PAPER COMPANY
Williamsport, Pa.

Why tear a sheet of sand paper to get a small piece? For convenience and economy, use U. S Sand Paper in rolls of various grits, widths and lengths.

U. S. Emery, Carbalox and Herculundum in rolls of various widths and grits should hang above the bench of every metal worker. Saves time: more economical.



Discs of Herculundum and Carbalox glued to horizontal or vertical wheels are great time savers in finishing castings and forgings to fit. The discs last long, both cloth and grit being just right for the work at hand. Write for the complete story on this.

Pipe Brackets to Support Bottom Boards of Wagon

ORDINARILY, in dumping a wagon, the bottom boards must be lifted over the high sides and placed on the axles. This is inconvenient and can be obviated if two brackets, as illustrated, are made for supporting the boards. For each bracket use three pieces of pipe, about 1 in. in diameter, screwed into two, 90-deg. elbows. In this way a convenient ledge is formed on which to place the boards.—E. W. BUERSTATTE.

This way of fitting wagon sides doubles the load

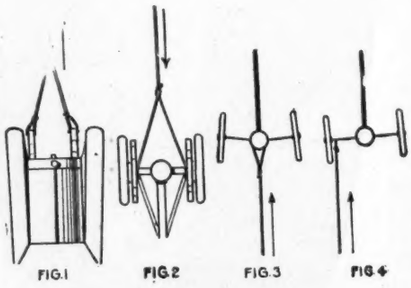
Towing a Disabled Car Without Injury

THE automobile that makes a business of towing disabled cars, as a rule, does not last long. Generally the main cause of their rapid destruction lies in improper fastening of the tow-lines.

The car being towed does not receive injury if the tow-rope is fastened to any part of sufficient strength to withstand the pulling strain. Still, it is better to attach the tow-rope to both ends of the frame, as in Fig. 1.

The nearer the fastening is made to the traction points of the towing car, the less strain the towing-car will have to undergo.

When the rope is attached to the differential housing, as in No. 3, the tendency is to spring the rear axle. When a connection is made, as in No. 4, the entire drag comes at one end of the rear axle, tending to pull the axle out of line. Of the two methods No. 4 is preferable if the tie shown in No. 2 cannot be made. Do not fasten the tow-rope to the frame of the car that is to do the towing.



At some time or other your car must be towed home. Here's the way to do it without injuring the car

When starting the car, move ahead slowly to take up the slack in the tow-rope without jerking. When under way, the driver of the towed car should keep the rope taut by using the brake if necessary.—RONALD L. PRINDLE.

Distant submarine, as seen through the range-finder.

When the Halves of the Conning-Tower Meet. Read the Range — and FIRE!

Do you know how our gunners find the range or distance of an enemy target—a submarine far off in gray wastes of sea, or an enemy post on a distant hillside? They train a "range-finder" on it, turn a screw till the halves of the image meet, and read the distance in yards or meters directly from a scale.

It is a matter of seconds only. Through deflection of light rays by a movable prism, the instrument measures angles and computes the distance, mechanically, accurately, instantly.

But distances are so great, and angles so infinitesimally small, that the slightest flaw in the glass, the slightest error in computation or formula, the tiniest deviation in edge or side of the many-angled prisms, will destroy the instrument's usefulness—turn a hit into a miss, perhaps victory to defeat.

That we were able in a great emergency to supply our Government not with the usual few score, as in former years, but literally with thousands of range-finders, and at no sacrifice of Bausch & Lomb scientific standards—

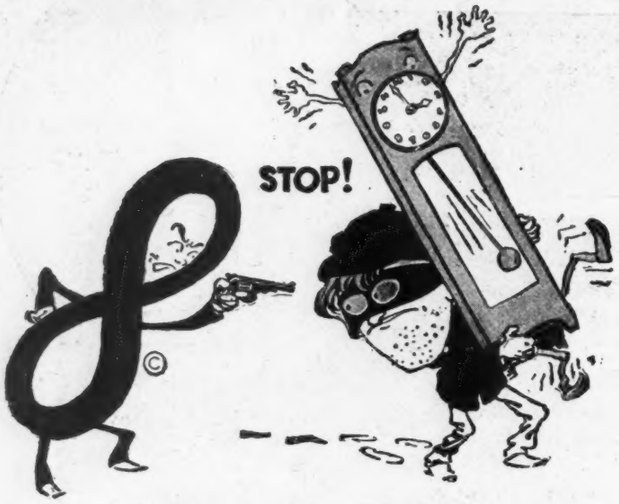
That even when working to a thousandth part of a millimeter we have been able to devise *machines* for large-scale production of range-finders, binoculars, gun-sights, aiming-circles, searchlight mirrors, periscopes—all the optical instruments of modern warfare—

This is both a source of pride to us, and a suggestion of our equipment for the improvement of optics generally.

Write for literature on any optical product in which you are interested.

BAUSCH & LOMB OPTICAL COMPANY . . . ROCHESTER, N. Y.

Makers of Eyeglass and Spectacle Lenses, Photographic Lenses, Microscopes, Balopticons, Binoculars and Engineering and other Optical Instruments



The Figure 8 saves time

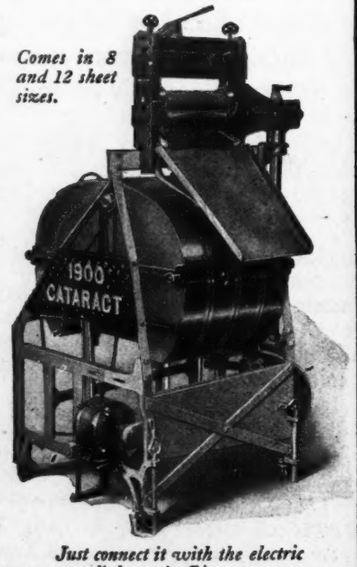
FOR it's the magic figure 8 motion of the water in the tub of the 1900 Cataract Washer that sends that water through the clothes four times as often as in the ordinary washer! Thus it washes the clothes faster and better.

When you use a 1900 Washer there's no danger of buttons flying off and button holes tearing out—not one single part in the tub to cause wear and tear! The hot cleansing water is forced through the clothes by the action of the tub alone and not by any parts! This means, too, that you don't have any heavy cylinders to lift out and clean.

These facts combine to make the 1900 the *perfect* washing machine. In addition, the swinging wringer—which also works electrically—can be shifted from the washer clear over to the clothes basket without any moving of the washer; the 1900 works easily and smoothly; costs less than 2c an hour to operate; washes a tubful of clothes in 8 to 10 minutes.

The water swirls through the tub in a figure 8 movement four times as often as in the ordinary washer.

Comes in 8 and 12 sheet sizes.



Just connect it with the electric light and off it starts.

Our Special Trial Offer

You may prove to yourself that the 1900 is the perfect washing machine. There is a 1900 dealer near you who will gladly demonstrate a 1900 Cataract Washer right in your own home. Then if you wish, you may start paying for it on terms to suit your convenience. Remember, we also have washing machines operated by hand and water power.

Write us today for the name of the nearest 1900 dealer, and a copy of the book "George Brinton's Wife." It's a story you will enjoy. Molly, his pretty little wife, had troubles of her own until she interrupted a bridge party, and then things began to happen.

1900 CATARACT WASHER

1900 WASHER CO., 206 Clinton St., Binghamton, N. Y.

Canadian Factory and Office
CANADIAN 1900 WASHER CO.,
357 Yonge St., Toronto

1900 WASHER COMPANY
206 Clinton St., Binghamton, N. Y.

Please send me the name of the nearest 1900 dealer, and a copy of the story "George Brinton's Wife."

NAME_____

ADDRESS_____

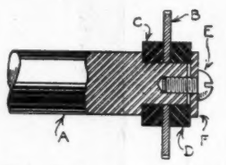
CITY AND STATE_____

An Apparatus for Slotting Instrument Bases

VERY often the amateur mechanic and model-maker has occasion to slot the bases of a number of instruments to allow wire connections to lie flush with the bottom. The apparatus described is used in a large shop where hundreds of bases, of all kinds of insulating material, such as hard rubber, wood, fiber, etc., are slotted with complicated arrangements of slots running in all directions on the base.

The device for doing the work consists of a length of shafting about ¾ in. in diameter and 18 in. long, with one end turned down to a ½-in. diameter, and back for about an inch. The saw used is a screw-slotting saw 1¾ in. in diameter with a ½-in. hole, costing but a few cents. The way the saw *B* is mounted on the spindle *A* is clearly shown by the cross-section illustration.

A thick ring or washer of fiber *C* is slipped on the turned-down portion of the spindle *A*, then the saw is slipped on, and is followed by another similar ring of fiber *D*. This last ring projects slightly beyond the end of the spindle to allow the machine screw *E*, which is screwed into a threaded hole tapped in the end of the spindle *A* and the metal washer *F*, to clamp the three securely together.



This tiny saw cuts the slot to the depth needed

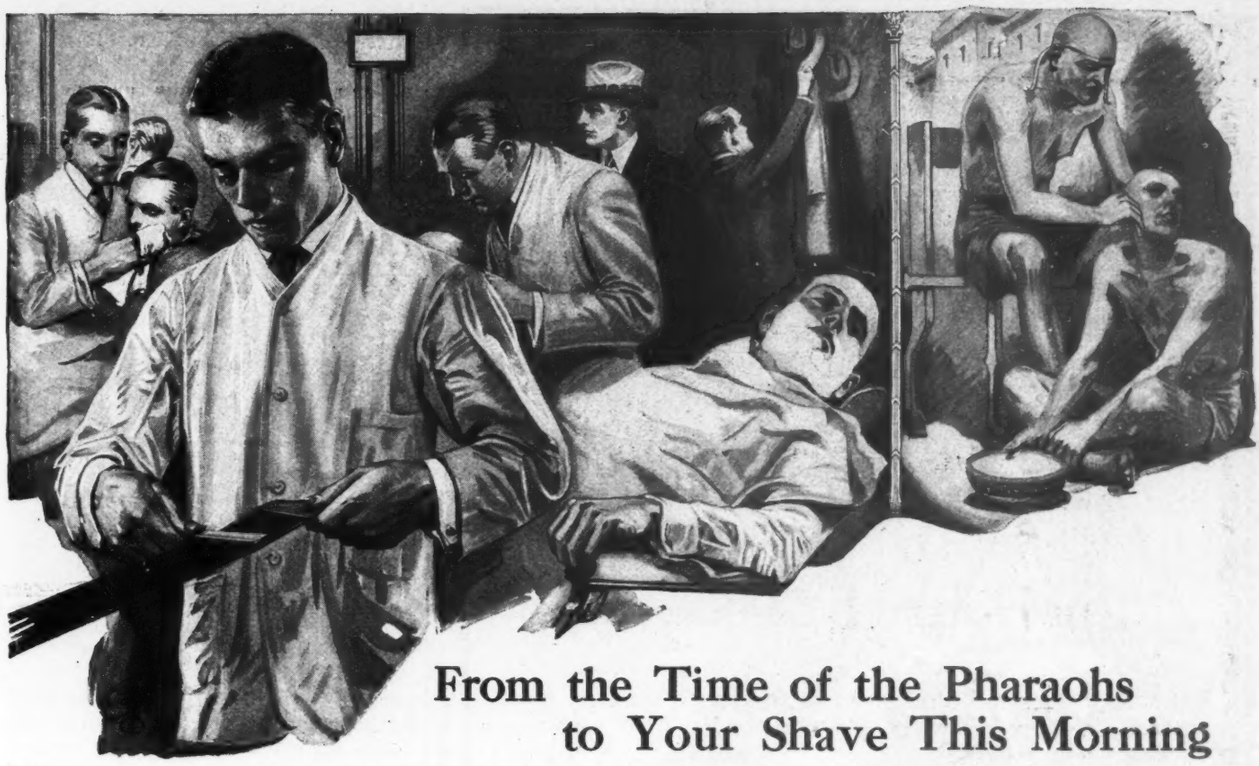
The diameter of the fiber ring regulates the depth of the slot to be cut, and a new set is required for each depth desired.

The spindle or shafting is held in the chuck of a speed lathe, with as much of it protruding beyond the chuck jaws as is necessary to allow the work to be done properly. The workman holds the base firmly in his hands, resting it against his chest to steady it. The saw is revolved with the teeth turning toward the operator and the work held against the bottom of the saw. If very sharp curves are to be made, a small saw must be used.—J. A. WEAVER.

A Double Punch for Paper, Fiber, or Rubber Washers

IT is frequently necessary to make a number of washers out of paper, thin fiber, or rubber, as shown in Fig. 1. If two punches are used it will be practically impossible to get the inside and outside circumferences concentric, and if a solid punch is used it will be hard to sharpen and the cut washers will be difficult to remove.

Fig. 2 shows a double punch that may be used to cut washers either by pressing by hand or by striking the punch with a hammer. It consists of two parts—the outer (Fig. 3) forming a punch to cut the outside diameter



From the Time of the Pharaohs to Your Shave This Morning

IN the VIIth Egyptian Room of the Metropolitan Museum of Art, New York City, there are two razors belonging to the time of the XVIIIth Dynasty (1580 B. C.)

The high-caste Egyptians of that period shaved not only the face, but the entire head. They wore wigs or other head-coverings. Those old Egyptian beards seen in ancient carvings were false beards. Sandals were owned only by the grandees, seldom worn, often carried by an accompanying slave.

The man being shaved squatted upon his haunches, the barber had the chair. And the razor then used, 3499 years ago, was the single-bladed, regular razor used by every barber without exception today.

Think of the many different sorts of razors that must have been invented, used for a time, and then dropped even from the long memory of History in the course of those 3499 years.

Those ancient razors were single-bladed like GENCO Razors of today. Barbers still use only this one type of razor, because a better tool for shaving purposes has never been discovered. Also, because they know, and will tell you if asked, that *any* blade must be stropped to deliver a perfect shave. You, too, can strop one regular razor for a perfect shave every morning.

Anybody Can Strop a GENCO Razor

Three features make stropping it almost as simple for you as breathing. Its broad back, its carefully concaved surface, and that important supporting bevel immediately behind the edge prepare each GENCO to lie against the strop just right. Your hand is guided. A few easy strokes—three or four each way, seldom over half a dozen—and there's that keen, smoothly cutting edge which every barber knows he has to have.

You save time. You save money. You begin the day with the sort of quick, cool shave that quickens your step and mind. The morale of a good shave—we don't need to go into that with you. You need only a regular razor for a real shave.

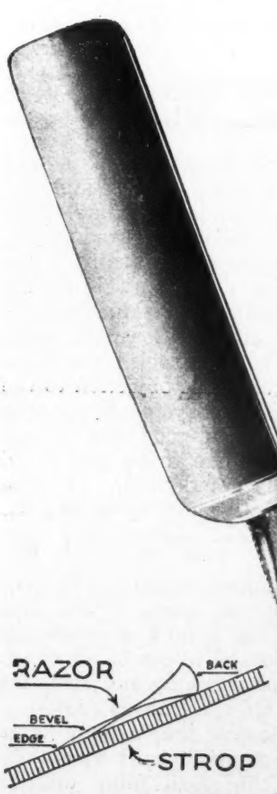
Your dealer will show you the three GENCO features. Each razor is hand-ground and delicately tempered. Look at the beautiful steel in it. We stand solidly behind it—"GENCO Razors must make good or we will."

If your dealer is out of GENCO Razors, write to us for one.

GENEVA CUTLERY CORPORATION, 47 Gates Avenue, Geneva, N. Y.

Largest Manufacturers of High-Grade Razors in the World

To Dealers: Inquiries and orders for GENCO regular razors arrive by every mail. We prefer to send you those coming from your town. Our handsome GENCO Display Cabinet free, with your first order, will make big Christmas sales for you. Write us today for additional information.



Note how GENCO Razors meet the strop in just the proper way to assure a perfect shaving edge. The bevel lends backbone to the edge and guides it on the strop.

Genco RAZORS

Reg. U. S. Pat. Off.

Choose Now

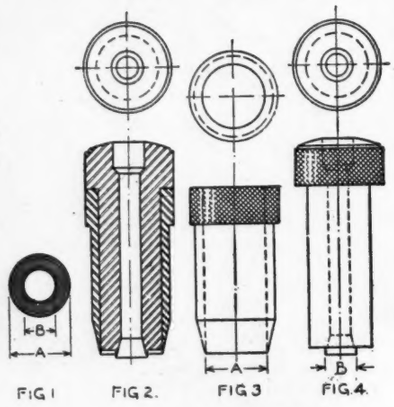
We back this Trade-Mark with our Reputation

THE WONDERFUL DAYS of Spring are "just over the hill"—and right now is the time for you to be choosing and buying the Dayton Bicycle that will make your every day a happier, more profitable day. For nearly 25 years Dayton Bicycles have been leaders in design, workmanship, quality, service and rider satisfaction. They are built with extra care and are best appreciated by those who demand superiority and painstaking attention to every little detail. Beautifully illustrated catalog pictures and describes 8 new 1920 Dayton Models—for boys, girls, men and women. Free. Write for Catalog 44 today.

Cycle Dept., THE DAVIS SEWING MACHINE CO., Dayton, Ohio

"Ride a Bicycle"

of the washer, and an inner one (Fig. 4) that punches out the hole. It will be noted that the outer punch is sloped off on the outside, while the inner one is tapered inside. The outer sleeve is drilled and reamed and the inner piece



Why buy a punch to cut out washers when you can easily make the one illustrated which serves a double purpose?

turned to make a good working fit without play. The inner punch extends slightly below the outer one, so as to get a firm hold on the material before the outer punch begins to cut. A hole through the center facilitates removal of the cuttings, and is counterbored at the top to prevent the inner hole being peened over from hammering.

For cutting paper or rubber it will not be necessary to harden the punches, but it is necessary if it is desired to cut fiber.—H. H. PARKER.

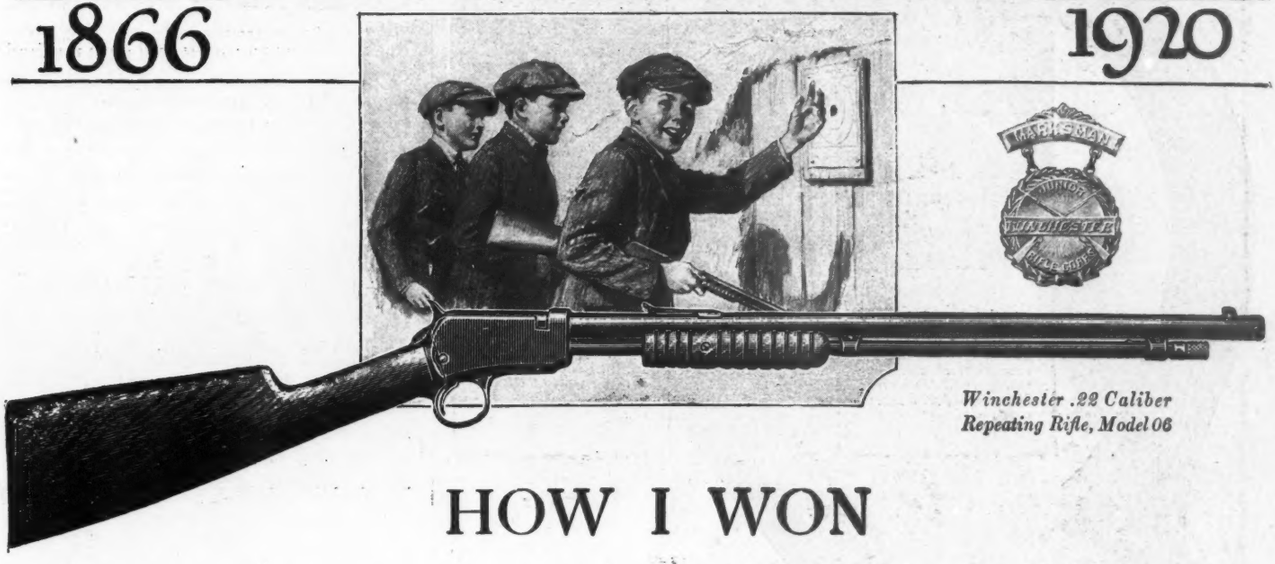
A Filing Envelope that Gives Flexibility

AN envelope filing system is very compact, and for the simple requirements of the home is one of the best that has been suggested to the POPULAR SCIENCE MONTHLY. For clipped matter, a series of big manila envelopes, alphabetically indexed under subject classifications, is much superior to the scrapbook formerly so much in vogue. The objection to the ordinary scrapbook system is one that is not flexible. A good deal of the filed matter is sure to be pasted in, which later is not desired. There is no convenient way of removing it, and so the dead matter keeps accumulating.

Here is a homemade filing container comprising three parts. The first part is the big manila envelope, as strong and durable as can be obtained. This envelope is sealed and then slit at one end. On the front is pasted a second envelope of the common letter size, the flap of which has been cut off. This holds the small filing unit, a piece of writing paper cut to fit inside. On this slip is entered a list of the larger envelope's contents. The writer finds this a good working file. The secret of its success is the index slip.—JOHN T. BARLETT.

WINCHESTER

1866 1920



Winchester .22 Caliber Repeating Rifle, Model 06

HOW I WON MY JUNIOR MARKSMAN MEDAL

WHEN my father bought me my new Winchester repeater, he said it was because I had joined the Winchester Junior Rifle Corps. But it really wasn't the fine medals that you can win in the W. J. R. C. that interested him. What he liked most of all was the rules.

The **W. J. R. C.** won't let you shoot for a medal unless you handle your rifle right and take proper care of it. Of course I wanted a medal, so I learned the Rules of Rifle Safety right away.

The distance you shoot in the W. J. R. C. is fifty feet. Five shots are fired at each target, when trying for a medal. If all five hit the bull's-eye, it counts 25. If they scatter, some shots count 4, 3, 2, or maybe nothing. It certainly is easy to scatter them!

Ten targets each counting 19 points or more, win a W. J. R. C. Marksman Medal and Diploma. It took me just three Saturdays to win mine, and I used only three boxes of cartridges.

Mr. Bradley, our instructor, says I have succeeded because I have followed the rules and done what he has told me to. But I also give a lot of credit to the fine accuracy of my Winchester repeater.

You don't really need a repeater. The rules just say you must use a .22 caliber Winchester. Lots of boys have the little single-shot kinds that cost very little. And Mr. Bradley says the steel in all Winchester barrels is the same quality and they are all bored the same way. He also says that many of the most expert small-bore marksmen in the world use exactly the same Winchester cartridges we do.

Next stop for me is Sharpshooter! The only W. J. R. C. Sharpshooter Medal in town that I know about, is on exhibition down at our leading hardware store. I don't think it is going to leave there very soon. But whoever else wants it, had better watch out for me and my Winchester repeater.

Let's go, boys! Each of you, hike down to the hardware or sporting-goods store in your community where they sell Winchester .22 caliber Rifles and Ammunition. Buy a rifle if you need one, and some ammunition; register your name as a member of the W. J. R. C., and ask for some targets and an instruction book. Then try your hand at winning a medal. Right away. If you need more information, write at once to us.

WINCHESTER REPEATING ARMS CO. ··· NEW HAVEN, CONN., U. S. A.

Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it in detail with Duracord.

*This is Duracord. Thick, heavy strands, **woven** like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*

You judge its strength

THE outside covering of a portable cable gives it its *mechanical* strength. Underwriters demand that the electrical strength, the copper and the insulation meet their requirements—but you must decide whether the covering makes the cord as strong as it should be where the wear comes—*on the outside*. You must decide between *braided* covering and *woven* covering. Economy demands the decision.

DURACORD
TRADE-MARK

is protected by a covering of thick heavy strands woven like fire hose. It can be battered and pounded and abused, and stands up as no other cord will. The illustrations tell part of the story.

No wonder Duracord resisted the pounding of heavy test hammers twenty times longer than braided cord. No wonder it withstood abrasion tests fifteen times longer than cord with ordinary covering. Field tests are even more convincing of its unusual strength. Made in all sizes for every purpose.

Let us send samples of Duracord and ordinary cord. Show them to your purchasing agent. Get your engineer's opinion. Test and compare them yourself. We'll rely on your judgment.

Ask your electrical jobber about Duracord, or write us.

TUBULAR WOVEN FABRIC COMPANY
Pawtucket, R. I.
Makers of Duraduct Flexible Non-Metallic Conduit.

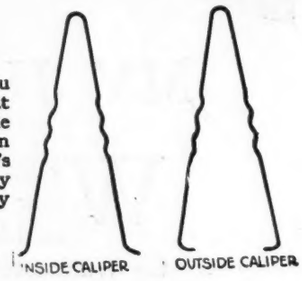
To Separate Boiled Eggs from Raw Ones

SOMETIMES, in preparing for picnics or in saving left-overs, boiled eggs are accidentally mixed with raw ones. Here is a quick and sure method of separating them: Place the eggs on a smooth surface and give them a twirl with the thumb and first finger. A boiled egg will spin around on its side just as one would expect it to do; but a raw egg will refuse to spin, however hard it is twirled.

The Hairpin Becomes a Pair of Calipers

A PAIR of calipers is perhaps the most frequently used tool in the machine-shop, being required for almost every kind of job.

One day the writer wished to take some outside measurements and he



couldn't find his calipers in the tool-box. His eye lighted on a scrub-woman in the next room and a bright idea came into his head. Why not beg a hairpin and make a pair of calipers with it? He followed up his idea, the measurements were taken, and when the job was finished it was found to aline properly.—A. G. VIDAL.

Cleaner-Cans Can Be Used as Nail-Containers

IT is often a problem for a carpenter to know how to carry nails, screws, etc., especially when he is using small brads, tacks, and hooks. Most carpenters use tea- and coffee-cans, but these have unpleasantly sharp edges.

One man solved the difficulty by using the discarded cans in which commercial bone-meal cleansers are commonly sold. These cans are made of heavy cardboard, and have a tin bottom.

By cutting a can in two, a box of any desired height from one to four inches is obtained. Such a box is light, strong, and of just the proper width for the fingers to enter. For larger nails, which occupy more space, it can be made higher. For small brads, screws, tacks, and the like, of which only small quantities are usually kept on hand, the box can be made shallow.

A great deal of petty annoyance is thus avoided.—HENRY SIMON.

Enjoy It!

MAKE your trips to and from work a pleasure instead of a mean ride on a hot, crowded car. Ride a bicycle. Enjoy to the fullest the exhilarating tonic of fresh air and the open country.

My, how good you feel! The red blood sings thru your veins, driving away those mean morning headaches and that old sluggish feeling! You get to work feeling like taking that old job and fairly "eating it up!" Health and a clear brain go a long way towards making a successful man. A bicycle goes nearly all the way towards making a healthy man!

Then think of the convenience. Think of the money saved. Think of the pleasure of long rides in the country—of happy trips over broad roads! Is it any wonder that more people are riding bicycles today than ever before?

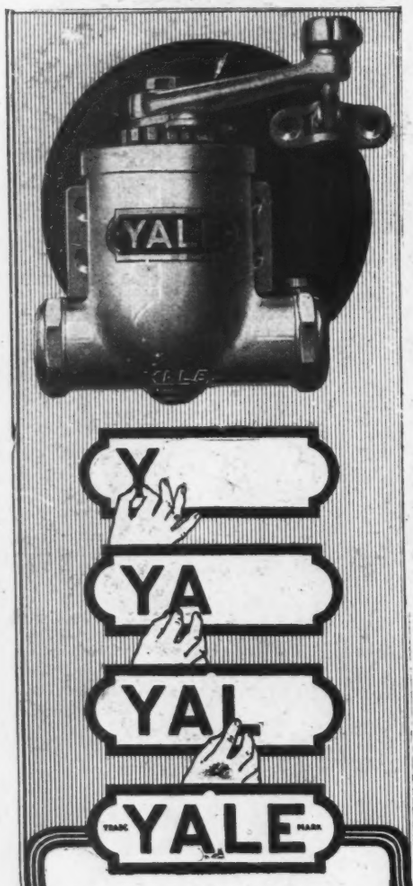
The bicycle is the most economical mode of transportation. It is the most healthful. It is a pleasant benefit for every member of your family.

Order your bicycle today. The more you ride it the more you'll enjoy it!

"Ride a bicycle"

The Cycle Trades of America, Inc.,

New York *U.S.A.*



Give your door a Yale Door Closer —and it will close as "Soft as cotton"

A DOOR not equipped with a Yale Door Closer is unwieldy, destructive, bothersome. It either crashes shut with a nerve-racking, plaster-shaking, splintering slam, or stays open, allowing chilly dust-and-germ laden drafts to sweep in.

A Yale Door Closer *completes* the door—closes it every time it is opened, silently, easily. It saves nerves, conserves heat and preserves the door itself.

Your hardware dealer will sell you the Yale Reversible Door Closer for main entrance, closet, library, kitchen, bath and screen doors. You can install them yourself, without knowledge of their internal mechanism.

See the trade-mark "Yale" on Yale Door Closers, the same trade-mark that guarantees Yale Cylinder Night Latches. Padlocks, Builder's Locks and Hardware, Chain Blocks and Electric Hoists.

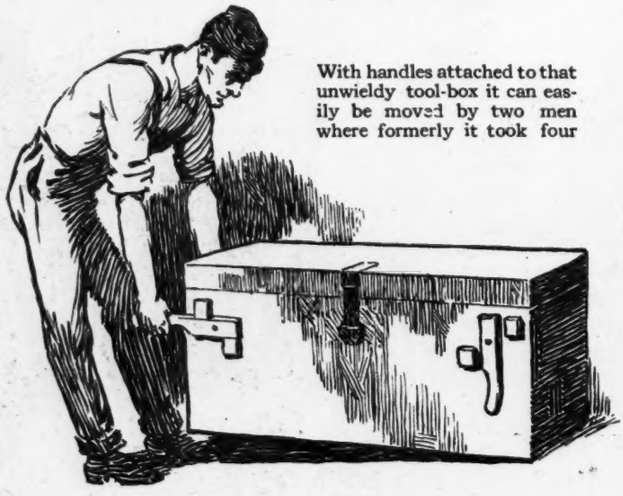
The Yale & Towne Mfg. Co.
Makers of the Yale Locks
9 East 49th. Street, New York City
Chicago Office: 77 East Lake St. Canadian Yale & Towne Ltd. St. Catherines, Ontario

When in New York or Chicago visit our Exhibit Rooms. You will be cordially welcomed.

Folding Handles Facilitate Heavy Lifting

By Thomas W. Benson

WHERE a number of mechanics are working together on a job, the usual practice is to keep all tools locked in a large box overnight. The illustration shows a simple method for equipping such boxes with folding handles that drop down out of the way when not in use.



With handles attached to that unwieldy tool-box it can easily be moved by two men where formerly it took four

The dimensions can be varied to suit requirements. For the average box the handles are cut from strips 18 in. long, 4 in. wide, and 1 in. thick. The hole for the pivot bolt is 6 in. from one end. The stops are cut from the same material and nailed or bolted in position. Washers should be used under the heads of the pivot bolts to insure easy action. The illustration also shows the handles in both positions. When filled with tools, the box, naturally, is very heavy. Without the handles it is hard work for four men to carry it from place to place. This necessitates calling them from other work to lift the box. Try this suggestion on your tool-box—it is a time-saver.

Adapting a Gasoline Engine to Burn Kerosene

By L. B. Robbins

THE mixer on almost every gasoline engine has an exposed air-intake valve. These valves are occasionally fitted with a gate for adjusting the amount of air admitted, but as a rule they are left at a fixed opening and the mixture adjusted at the gasoline supply.

In such cases it is a simple matter to readjust the proportions of air and fuel so as to run the engine equally well on kerosene as on gasoline. This can be done to the usual style of mixer by inserting a rightly proportioned bushing in the mouth of the air intake itself. If the mouth of the intake projects downward tap into it an elbow, so that the mouth will be either horizontal or upright.

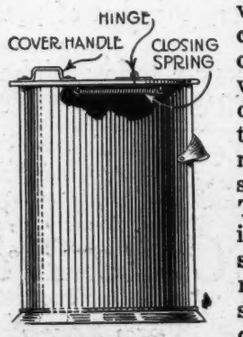
Kerosene is much less volatile than gasoline, and the object is, of course, to gasify it as quickly as possible. This calls for a little experimenting.

First, with a bushing in the air intake, pour in a little gasoline, and, closing the ignition switch, turn over the flywheel and start the engine. When it picks up on the gasoline turn the needle valve of the mixer so as to admit about half the amount of kerosene that it formerly admitted of gasoline. If the engine slows down pour in a little more gasoline until the cylinder becomes well heated. After a few moments of running the kerosene can be gradually cut down until the engine is operating on about a third the amount of fuel that was formerly used. When the proper points on the needle valve indicator are once located, mark them and you will always be able to operate the engine satisfactorily.

It is suggested that this arrangement be made on a marine or stationary engine of from one to four cylinders. It will not work to advantage upon an automobile engine, because the use of kerosene causes the cylinders to carbonize quickly.

A Soiled Waste Receptacle for Machine-Shops

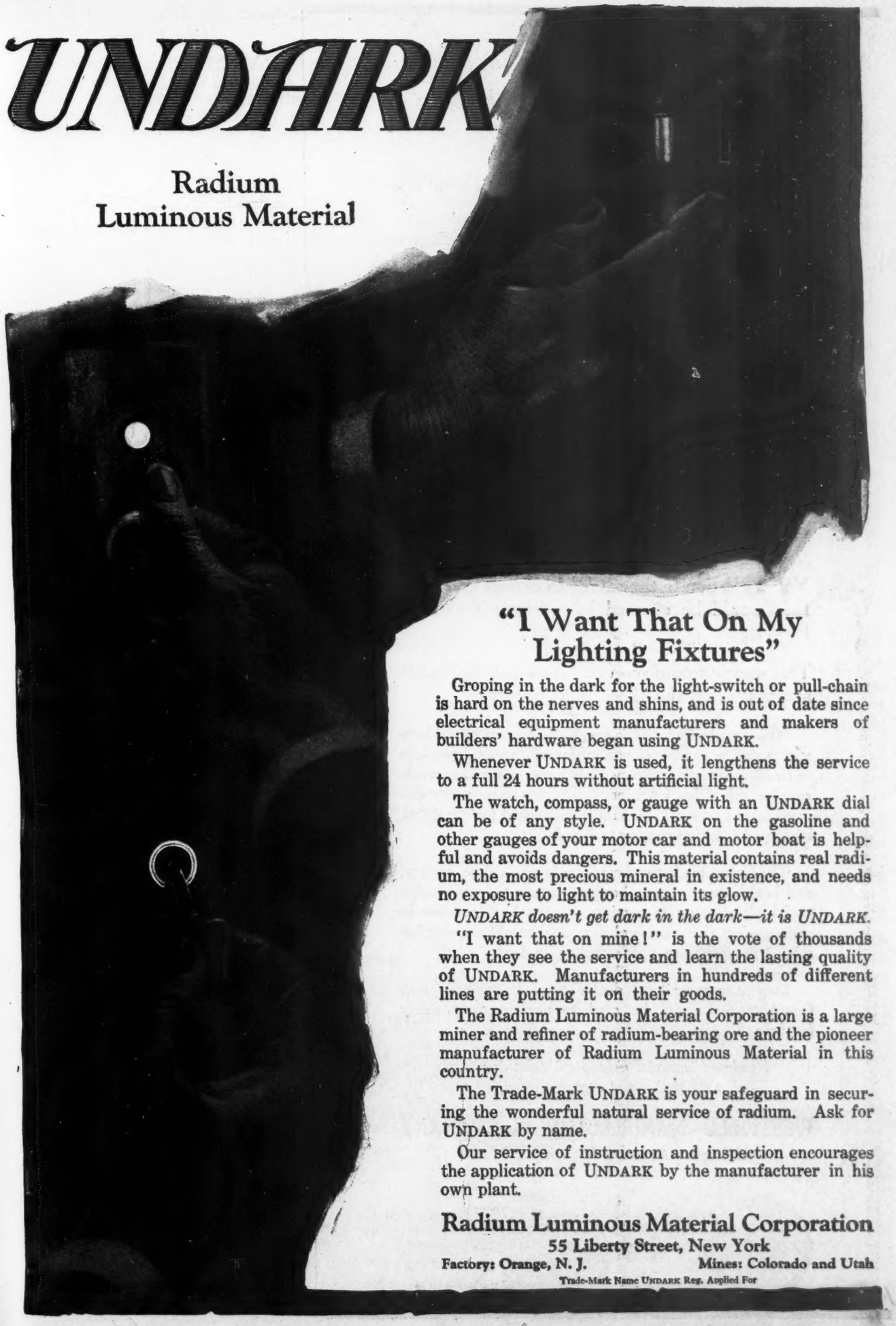
IN factories and work-shops where a lot of oily waste accumulates, some sort of safety waste receptacle should be provided. A waste can such as the one illustrated will prevent the danger of fire through carelessness and the resultant loss. The main feature is the closing spring which makes it impossible for the cover to remain open unless held in place.



By using a metal container for oil waste you avoid fire danger

UNDARK

Radium Luminous Material



"I Want That On My Lighting Fixtures"

Groping in the dark for the light-switch or pull-chain is hard on the nerves and shins, and is out of date since electrical equipment manufacturers and makers of builders' hardware began using UNDARK.

Whenever UNDARK is used, it lengthens the service to a full 24 hours without artificial light.

The watch, compass, or gauge with an UNDARK dial can be of any style. UNDARK on the gasoline and other gauges of your motor car and motor boat is helpful and avoids dangers. This material contains real radium, the most precious mineral in existence, and needs no exposure to light to maintain its glow.

UNDARK doesn't get dark in the dark—it is UNDARK.

"I want that on mine!" is the vote of thousands when they see the service and learn the lasting quality of UNDARK. Manufacturers in hundreds of different lines are putting it on their goods.

The Radium Luminous Material Corporation is a large miner and refiner of radium-bearing ore and the pioneer manufacturer of Radium Luminous Material in this country.

The Trade-Mark UNDARK is your safeguard in securing the wonderful natural service of radium. Ask for UNDARK by name.

Our service of instruction and inspection encourages the application of UNDARK by the manufacturer in his own plant.

Radium Luminous Material Corporation
55 Liberty Street, New York
Factory: Orange, N. J. **Mines: Colorado and Utah**

Trade-Mark Name UNDARK Reg. Applied For

458 Cities in 48 States have increased Street car fares - more than 35,000,000 people affected

The ANSWER

the nation's lowest cost, most dependable means of transportation-

Columbia BICYCLE

You *can* estimate the saving in dollars and cents that would be effected by riding a Columbia Bicycle.

This saving would soon pay for a new Columbia and you could then keep right on saving.

You *cannot* estimate the great *physical* and *mental* benefits a full season's use of the Columbia would produce — freedom from crowd-packed cars, from uncertain running schedules, from lost time, from those many discomfitures and work interruptions caused by unsettled, inadequate, and expensive trolley facilities.

The Columbia is the American family's time, money, and health saver. It makes getting to and from work a healthful, pleasurable pastime. Light but sturdiest in construction, dependable always, comfortable, up-to-the-minute in style lines, finish, and equipment.

Step into your local dealer's and inspect the new Columbias — he will be glad to explain their many features.

Handsome illustrated Columbia Catalog describing all 1920 models sent anywhere on request.

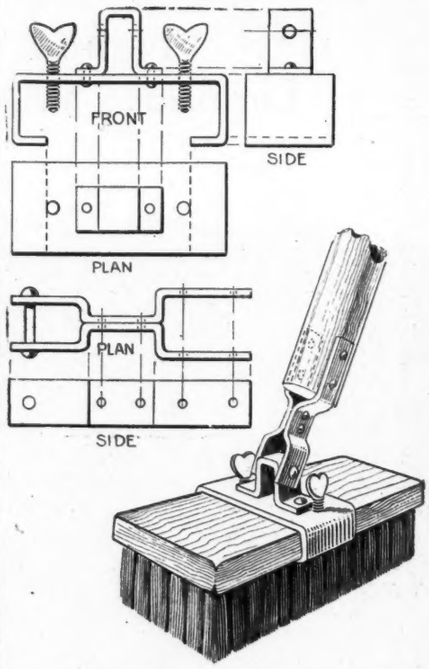
WESTFIELD MANUFACTURING COMPANY

45 Lozier Avenue, Westfield, Mass.

RIDE A BICYCLE

Stand Up When You Scrub the Floors

A VERY useful article and labor-saving device can be easily constructed from strap-iron. It will fit any scrubbing-brush of standard size and is designed with the idea of preventing you from assuming the old-time knee position, which is so tiring.



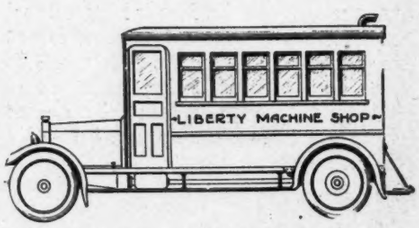
Scrubbing-brushes must be used at least once a week: why not make them as easy as possible to handle?

The top of a broom is used for the handle, and the device itself is explained in the detailed diagram herewith. Two wing-bolts make the device adjustable. Any thickness of brush can be used from ¼ to ¾ in. and any width from 2 to 3 in.

An Old Automobile Made into a Portable Machine-Shop

WISHING to better himself, an enterprising street knife-grinder gathered together enough money to purchase an old discarded jitney bus, and turned it into a self-propelled and self-operating machine-shop on wheels.

All the seats except the driver's were removed, a hole was cut in the floor for the belt, and a split pulley attached to the drive-shaft in line with the hole. The size of the pulley was adapted to the speed of the line shaft.



Instead of the customer coming to the shop the shop goes to the customer

A Remedy for Present Day Gasoline

NEARLY everyone knows that gasoline has gone down and down in grade. The fine gas of five years ago may still be purchased, but at drug store prices.

The common run of gas today has played havoc with many engines.

It has made them difficult to start on a cold day; causes frequent back firing; scored cylinders, burned bearings, abnormal carbon deposit, and amazingly frequent grinding of valves.

Many engineers saw this condition coming years ago, but the Chalmers engineers were the first to develop a remedy.

They knew there was as much power in a low grade gas as in a high grade gas.

To get out all the power that nature put in was the task.

They designed two devices—Hot Spot and Ram's-horn.

Hot Spot "cracked up" the gas to a very fine vapor after the gas left the carburetor, and then turned over the fine vapor to Ram's-horn, which dispatched it a short and equal distance to each cylinder.

The effect on gas upon striking Hot Spot is like a drop of water striking the top of a hot stove.

Imagine the "cloud" of gas then rushed through Ram's-horn, which is minus sharp corners, abrupt bends and pockets; the distance to cylinders 1 and 6 being exactly the same as to the middle cylinders.

The result is instantaneous firing; instantaneous power; no "coughing" or backfiring. Instead quick acceleration, smooth action and vibration reduced to a negligible quantity.

Your first impression in a present day Chalmers is instantaneous starting on a cold day.

Your second impression is quick power results—you do not have to run two blocks to get your engine "warmed up."

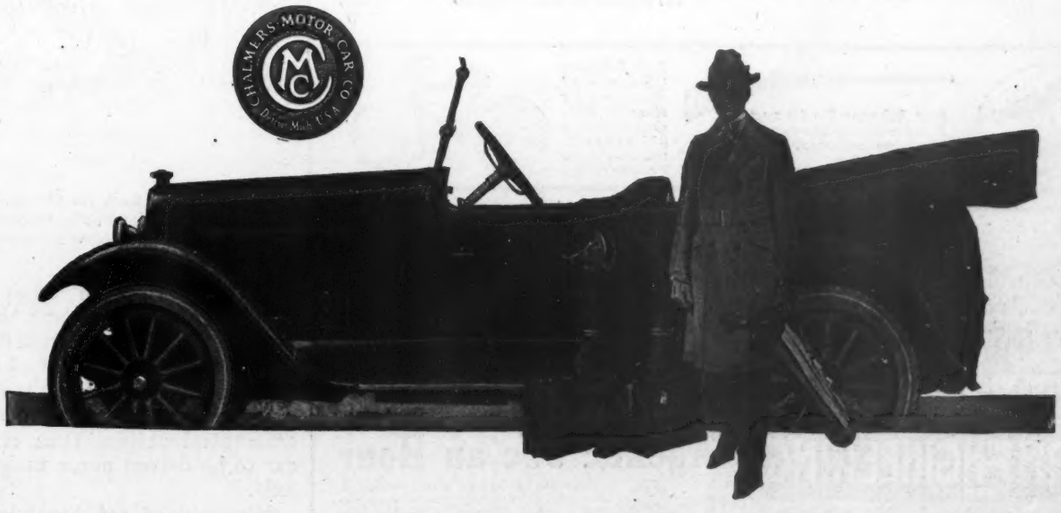
Your third impression is a total absence of vibration.

CHALMERS MOTOR CAR CO., DETROIT, MICH.

CHALMERS MOTOR CO. OF CANADA, LTD., WINDSOR, ONTARIO
MAXWELL MOTOR CO., INC., EXPORT DIVISION, 1808 B'WAY, NEW YORK

CHALMERS

WITH HOT SPOT AND RAM'S-HORN



IVER JOHNSON
SAFETY AUTOMATIC
REVOLVER

The Sign of Positive Safety

Iver Johnson means Safety, and Safety means Iver Johnson —the two are inseparable.

Drop it, kick it, knock it, thump it, "Hammer the Hammer"—it can't go off accidentally. And its safety is automatic—nothing to remember to do to make it safe. That's why women are not timid about having an Iver Johnson in the home.

Choice of three grips

Regular, Perfect Rubber, Western Walnut.

Three Booklets, one or all FREE on request
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"B"—Bicycles
"C"—Motorcycles

If your dealer hasn't in stock the particular model you want, send us his name and address. We'll supply you through him.

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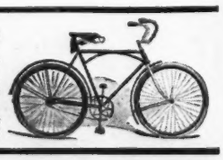
Iver Johnson Single and Double Barrel Shotguns combine accuracy and dependability.

Iver Johnson "Superior" Roadster Bicycle $55. Other Models $37.50 to $65. [No extra charge for Coaster Brake]



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Introduce "Soderese." A new wonder. A pure solder in paste form. Works like magic. Stops all leaks. For mending water buckets, cooking utensils, milk pails, water tanks, tin roofs—everything including granite ware, agate ware, tin, iron, copper, zinc, etc.

Quick Sales—Nice Profit

Everybody buys. Housewife, mechanics, electricians, jewelers, plumbers, tourists, automobilists, etc. No leak too bad to repair. Just apply a little "Soderese," light a match and that's all. Put up in handy metal tubes. Carry quantity right with you. Write for sample and special proposition to agents.
AMERICAN PRODUCTS CO., 2048 American Bldg., Cincinnati, Ohio

Along one side a bench was built up the proper height and shelves placed beneath it. The opposite side was fitted with a tier of drawers, while at the rear end of the bench was placed the forge, which is one of the hand-power kind. A small bench lathe, as well as a grinder, was placed on top of the bench at the front end, and a vise at the rear.

A smoke-draft hood was hung over the forge, and its smokestack run through the roof. The line shaft for running the lathe was hung in hangers to the roof. The driving pulley for this shaft has a clutch, so that when the machine-shop is on the move the machinery of the shop can be stopped.

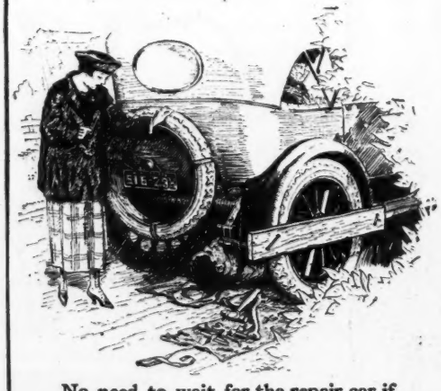
It was found that the original dome lights were not strong enough for the work, and two large barn lanterns were placed over the bench. These burned kerosene, and consequently it was not necessary to charge the storage battery to run the lights.

An acetylene welding tank and torch is carried in a rack made for the purpose, and the grinder has a very efficient money-making shop on wheels driven by its own power plant.—P. P. AVERY.

A Quick Road Repair on a Broken Automobile Axle

IF your automobile's rear axle, either right or left, breaks, a quick "get home" job can be made with a taper punch and a piece of board.

Remove the differential case-cover, insert the punch in the hole to keep it from turning, and wire the board fast to the running-board and the rear end of the spring or mud-guard, as shown in the illustration. The board holds the axle in, and the punch keeps the axle and its gear from making the differential action, thus allowing the car to be driven home under its other axle.



No need to wait for the repair car if you adopt the above suggestion for repairing your broken automobile axle

Nine out of ten breakdowns occur in out-of-the-way places, and usually the driver is without the proper tools or parts to repair the break. By observing other motorists' methods of emergency repairs you will not be at a loss for a solution when your breakdown arrives.—P. P. AVERY.

CHAIN TREAD

The Chain Tread Tire goes straight ahead—no side-slipping or veering from the straight path—a skid with a Chain Tread Tire is an unknown quantity. And then see the bulk of good rubber in that Chain Design and then figure out the advantage you are going to gain from it in wearing qualities as well as the insurance it is to your safety. You'll make the best selection in the world when you put UNITED STATES CHAIN TREADS on your Bicycle.

Be sure it is United States

"I'll be on time"

If the alarm clock fails, you can still keep your appointment with the time clock, if you own a bicycle.

There is no waiting for cars. Jump astride and be off with speed to spare.

And remember that the most efficient bicycle is equipped with the most dependable tires—United States Tires. Made by the world's largest rubber manufacturers to live up to an established reputation for long and trustworthy service.

United States Cycle Tires are Good Tires

The most a man can expect in a pipe—and just a little more. The WDC is a pipe you have a right to be proud of. Genuine French Briar, Demuth seasoned, and guaranteed against cracking or burning through.

WM. DEMUTH & CO., NEW YORK
WORLD'S LARGEST MAKERS OF FINE PIPES

WD C TRADE MARK

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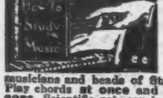

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STANDARD FOOD AND FUR ASS'N
307C Broadway New York

Manufacture Your Own Old Rose and Heliotrope

THE apparatus necessary to make perfume at home is quickly gathered together about the house, and perfume made in this way carries a far sweeter odor than the majority of manufactured perfumes.

First, secure two empty bottles. One of these is to hold the flowers and should be of ample size and have a neck large enough to admit the neck of a smaller bottle. Into the neck of this smaller bottle place a piece of very fine sponge, washed clean, then saturated with pure olive oil, and squeezed dry.

Those of you who have flower-gardens can make your own perfume. It is much sweeter than the store kind

Fill the larger bottle with flowers; any kind will do as long as they have a sweet odor and are fresh. Fit the bottles together and place them in the sun. Next day throw out the old flowers, squeeze out the extract in another small, tightly corked bottle, and place new flowers in the bottle. Keep this up until the small bottle is filled with perfume, squeezing out the few drops each day. It is necessary to oil the sponge only once.

For each drop thus secured add one ounce of pure alcohol.—G. F. COLLINS.

Why Trade in Your Old Automobile?

THE engine of a good car will continue to function well years after the top and the finish on the body have become shabby. In fact, many cars are "traded in" just when the engine is at its best. All mechanics know a new piece of machinery doesn't operate smoothly until it has been run some time. Meanwhile the paint, varnish, lacquers, etc., put on to make it look attractive have lost their newness.

It is waste to discard a perfectly good engine just because the outer shell doesn't look as spick and span as it might. That defect is easily remedied.

The History of a Word

THE trade-mark "KODAK" was first applied, in 1888, to a camera manufactured by us and intended for amateur use. It had no "derivation." It was simply invented—made up from letters of the alphabet to meet our trade-mark requirements.

It was short and euphonious and likely to stick in the public mind, and therefore seemed to us to be admirably adapted to use in exploiting our new product.

It was, of course, immediately registered, and so is ours, both by such registration and by common law. Its first application was to the Kodak Camera. Since then we have applied it to other goods of our manufacture, as, for instance, Kodak Tripods, Kodak Portrait Attachments, Kodak Film, Kodak Film Tanks and Kodak Amateur Printers.

The name "Kodak" does not mean that these goods must be used in connection with a Kodak camera for as a matter of fact any of them may be used with other apparatus or goods. It simply means that they originated with, and are manufactured by, the Eastman Kodak Company.

"Kodak" being our registered and common law trade-mark can not be rightly applied except to goods of our manufacture.

If you ask at the store for a Kodak Camera, or Kodak Film, or other Kodak goods and are handed something not of our manufacture, you are not getting what you specified, which is obviously unfair both to you and to us.

If it isn't an Eastman, it isn't a Kodak

EASTMAN KODAK COMPANY,
ROCHESTER, NEW YORK.

Grandma Knows Musterole Is Best

Remember the time when you had that dreadful congestion of the lungs—and Grandma slapped a stinging, messy mustard plaster on your chest? How you writhed and tossed and begged Grandma to "take it off"?

That was many years ago. Now, Grandma gets the jar of Musterole, for now she knows Musterole is *better* than a mustard plaster.

She knows that it relieves colds, congestions, and rheumatic aches and pains.

And what is best, it relieves *without discomfort or blister.*

Musterole is a clean white ointment made of oil of mustard and other home simples.

Just rub it gently over the spot where there is congestion or pain. It penetrates down under the skin and generates a tingling, pleasant heat. Healing Nature does the rest. Congestions and pains both go away.

Peculiarly enough, Musterole feels delightfully cool a few moments after you have applied it.

Never be without a jar of Musterole.

Many doctors and nurses recommend it. 30c and 60c jars. $2.50 hospital size.

The Musterole Co., Cleveland, Ohio

BETTER THAN A MUSTARD PLASTER

MUSTEROLE
WILL NOT BLISTER

Play the Hawaiian Guitar

Just Like the Hawaiians!

Our method of teaching is so simple, plain and easy that you begin on a piece with your first lesson. In half an hour you can play it! We have reduced the necessary motions you learn to only four—and you acquire these in a few minutes. Then it is only a matter of practice to acquire the weird, fascinating tremolos, staccatos, slurs and other effects that make this instrument so delightful.

The Hawaiian Guitar plays any kind of music, both the melody and the accompaniment. Your tuition fee includes a beautiful Hawaiian Guitar, all the necessary picks and steel bar and 52 complete lessons and pieces of music.

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I am interested in the HAWAIIAN GUITAR. Please send complete information, special price offer, etc., etc.

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Things I Made that Reduced the High Cost of Living

The Popular Science Monthly will pay fifty dollars for the best answer

WHAT new use of a mechanical appliance or machine did you make for the purpose of reducing the high cost of living? We know of one fellow that transformed his coal furnace into an oil burner. Another made an iceless refrigerator. There are, of course, many other things and we want to know in how many practical ways we can reduce living expenses. Tell us! THE POPULAR SCIENCE MONTHLY offers three prizes,—a first prize of $50, a second prize of $25, and a third prize of $15,—to be awarded in accordance with the rules set forth below:

Rules Governing the Contest

(1) Contestants are not limited to the number of methods of reducing the high cost of living, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.

(2) The method must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the use of the appliance very clearly. The contestant's name and address should appear on each sheet of drawings.

(3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.

(4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 p. m. on Friday, April 30, 1920.

(5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.

(6) The first prize of $50 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of reducing the high cost of living.

The second prize of $25 will be paid to the contestant who submits a method next in merit.

The third prize of $15 will be paid to the contestant who submits the method third in merit.

(7) The winners of the contest will be announced in the earliest possible issue of the POPULAR SCIENCE MONTHLY. A description of the methods which win the three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.

(8) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.

(9) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.

(10) Manuscripts or drawings will be returned to contestants if stamps are enclosed.

(11) Send drawings and specifications to the High Cost of Living Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

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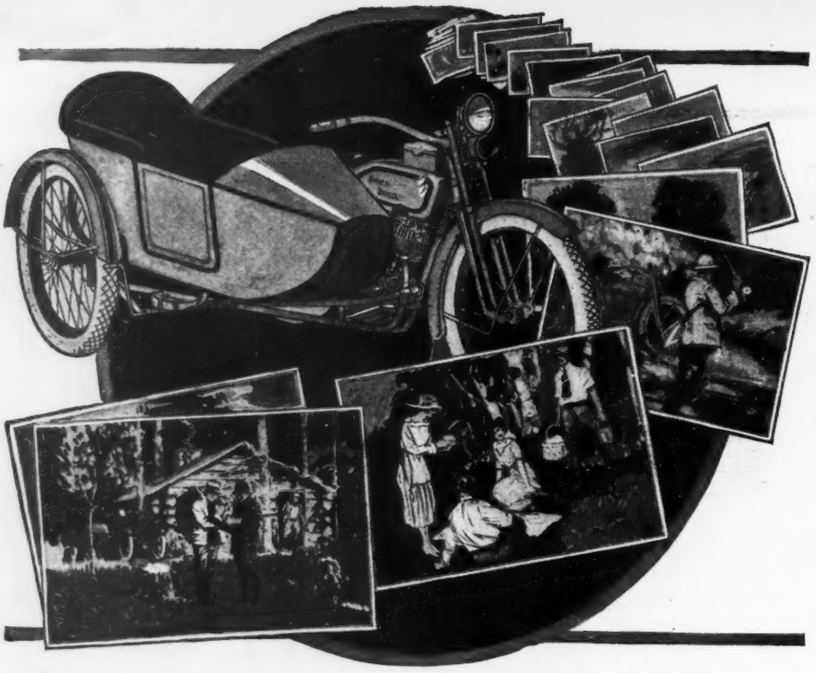

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Harley-Davidson

"World's Champion"

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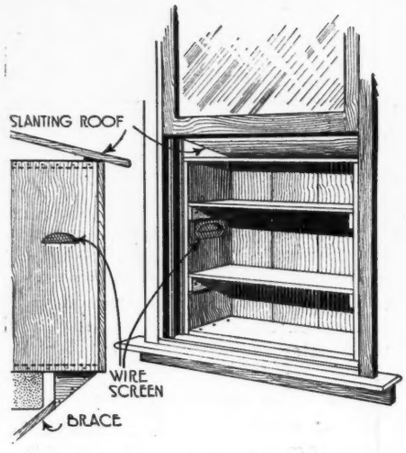
A Homemade Cold-Box for the Pantry Window

NOT all food preservatives are designed for the protection of eatables from warm temperatures. The accompanying illustration describes a food-container used exclusively in cold weather; hence the name cold-box.

The container is homemade, and can be attached to the outside of the kitchen or pantry window. A



The side view and front of the box show how easily it can be constructed. It will save you a big ice bill, too

northern exposure is desirable; raising the window gives access to the cold-box, without shutting off the light from the upper half of the window.

The window-sill is extended by a shelf, supported by wooden brackets. The device rests on the window-sill and the extended shelf, being fastened to the window-cases by screws or nails near the top and bottom of each end of the box. The box should have a sloping top to ward off rain. Holes for ventilation are made in the end of the box, and screened. Shelves may be made of heavy screen, poultry netting, or wood. The shelves rest on cleats fastened to the sides of the box.

Food placed in the box should be covered, as a safeguard from dust. In warm weather the cold-box can be removed if desirable.—S. R. WINTERS.

Hints for Those Who Want Tire Mileage

IN the United States today there are more than one hundred legitimate tire manufacturers, and about fifteen of this number supply practically all motorists. The smaller tire manufacturers, the "seconds" shops, the "cut-rate" and the "retread" shops, take care of what business the big manufacturers do not handle. This business is growing by bounds, and each day new motorists and even thousands of old-timers are buying cheap tires. This is like getting a quack doctor when one is seriously ill. Tire value shows itself in the cost per mile, not in the cost per tire. As in

everything else, the best tire is the cheapest in the long run, and the motorist who buys cheap tires finds that the cost per mile is much higher than is that for a standard high-grade tire.

In every large city there are shops displaying the sign "Standard Makes, 50 per Cent Off," and naturally the unwise are led to believe that they will get a regular first-grade tire at 50 or 30 per cent less than the standard tire branches can sell them for. In some of these shops you find that the tire has a name strange to you. It might be Clingstone or Soft-tread or some other name you never heard of; but the salesman tells you that it is a standard make and that this particular company is launching a new tire that is branded differently on account of its tread.

This is not the case. Standard makers take pride in stamping their trademark on their tires. A certain class of tire manufacturers do a regular business with these concerns, manufacturing tires under any name the dealer wants. Other factories market tires through various trade channels, selling as many as ten different brands of tires. These may be all from the same stock and design, though differing greatly in price. The

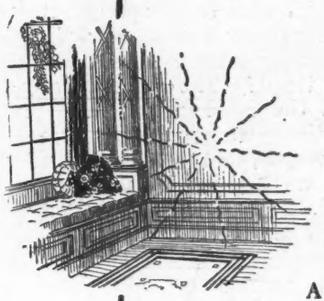
Did that second-hand tire you bought recently go bad? Read the article and learn just why it wasn't any good

tire list in this case is a joke, because the tires never sold at list prices at all. If a tire is listed at $50 it is offered to you at 50 per cent off or $25; and this is perhaps more than the tire is worth.

Every manufacturer has a certain number of "seconds" which he must dispose of in the best way possible. The so-called "rejects" are bought up by dealers, who purchase in large lots. Included in these "seconds" are old tires that have been in stock for a long time.

When you buy a "second" tire you are taking a big chance. It may last ten miles or it may run eight thousand. If the tire happens to blow out in a short time, you lose; if it doesn't, you are lucky.

Then perhaps you buy a second-hand casing. You can't tell by look-



Walled up Alive!

A startling truth develops when the new home is all built and folks start living in it.

All the bigger problems of plan and architecture grow daily less vital. The small conveniences, insignificant when planned, become the very means to family comfort.

Indeed, the incidentals in building actually become the requisites to living—and this is never more true than electrically.

That head of stairs switch to insure your footsteps against darkness means more in your daily life than the design of the roof, whether mansard or pitched.

The reading light alongside your bed offers more real human satisfaction than the style of your windows, be they dormer or bay.

And whether you planned the library for the first or second floor doesn't hold half the importance of an arrangement of lights kindest to your eyes.

There's a Niagara of energy running through the walls of your house. But how to tap it? Walled up alive in lath and plaster, this powerful servant is restive, eager to shine and cook and sew for you.

Arrange the necessary outlets and it will emerge to take up the work. Base-board outlets, placed plentifully in every room and hall. In the laundry for washing machine and iron. In dining room for toaster and grill, in bedroom and living room for vacuum cleaner.

Comforts you value but don't always provide. Trouble is, you don't call your electrical contractor in until the building is well along. Then first estimates of cost begin to prove inadequate and common sense seems to say save, do without, cut.

Don't do it.

Remember that you are building a home to live in. That additional electrical equipment costs relatively little, and that a few extra fittings will yield endless convenience and satisfaction.

Talk it over with your architect and your electrical contractor.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

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No. 3 *Don't think only of Western Electric as a name on your vacuum cleaner or iron, but also as an organization which serves in street lighting, in safe and rapid travel, in communication by wire or wireless—and in every other field of electrical achievement.*

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Toolmaker	BUSINESS MANAGEMENT
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CIVIL ENGINEER	BOOKKEEPER
Surveying and Mapping	Stenographer and Typist
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ing at it, or even by examining it closely, just how far it has run or how much mileage is left in it. A fabric break may not be visible, yet such a break will sooner or later cause a blow-out.

Retreads are in another class. An old tire carcass, properly retreaded, looks exactly like a new tire. The tread may seem new, but what good is a tread? The tread merely protects the fabric. The fabric is the real tire. There are good treads and bad treads, and you cannot tell what you are buying by looking at the tread.

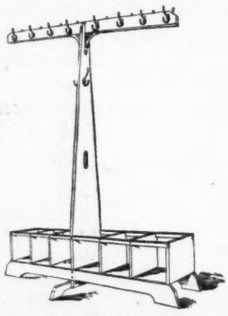
This is not condemning retreading, because a good carcass is always worth retreading. There are many concerns that retread old casings in which the fabric is still good, and in this case the owner gets good return for his money.

Here is the best advice for tire-buying: Buy the very best tires you can afford, inflate and take care of them properly, and you will get the greatest return in service for your dollars.

Doubling the Capacity of the Clothes-Closet

PERHAPS there is nothing that the housewife has wished for more often in the home than additional closet room.

The average closet is provided with hooks around the walls only. This arrangement leaves a great deal of wasted space in the center of the closet which we often wish could be utilized.



By installing this clothes-hanger you increase the capacity of your clothes-closet

The accompanying illustration shows an easily constructed contrivance designed to make use of this wasted space in the closet, which at the same time can be easily removed when the semiannual house-cleaning time comes round.

It consists of a specially designed clothes-tree, to be placed in the center of the clothes-closet, providing a number of clothes hooks and also a place below for storing extra pairs of shoes.

Of course, the size of the hanger should be regulated to fit your own needs and the closet in which it is to be used. The one illustrated was just 64 inches from the floor to the top of the cross-bar, and was provided with an opening in the center of the upright, as shown, so that it could be lifted with ease.

After the device was completed it was given a good coat of flat white paint.—MORTIMER V. TESSIER.

Last Big Block
OF THE CANADIAN PACIFIC RESERVED FARM LANDS

THIS announces the offering of the last big block of the Canadian Pacific Reserved Farm Lands. Until this block is disposed of you can secure at low cost a farm home in Western Canada that will make you rich and independent. Never again on the American Continent will farm lands be offered at prices so low.

Last Big Opportunity

This block contains both fertile, open prairie and rich park lands in Lloydminster and Battleford Districts of Central Alberta and Saskatchewan. Farm Lands on the rich prairies of Manitoba, Saskatchewan and Alberta, averaging about $18.00 an acre. Lands in Southern Alberta under an irrigation system of unfailing water from $50 an acre up.

Twenty Years to Pay

The Canadian Pacific offers you this land under a plan of long term, easy payments that is remarkable in the history of farm investments. You pay down 10%. Then you have no payment on the principal until the end of the fourth year, then fifteen annual payments. Interest is 6%. In Central Saskatchewan, Seagar Wheeler grew the world's prize wheat. World's prize oats were grown at Lloydminster.

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In Southern Alberta, the Canadian Pacific Railway has developed the largest individual irrigation undertaking on the American Continent. This district contains some of the best lands in Canada. An unfailing supply of water is administered under the Canadian Government. Prices range from $50 an acre up on the same easy payment terms. $2000 loan in improvements. Twenty years to pay back.

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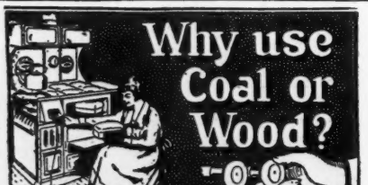

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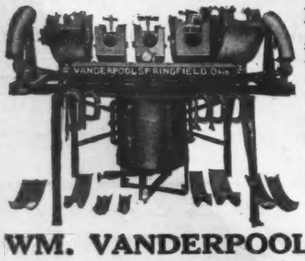

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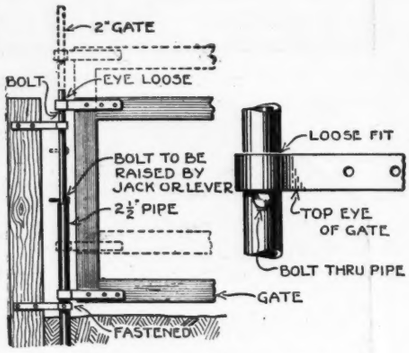
Jack Up the Gate to Clear Obstructions

WHEN the snow flies and banks up in front of the big gate, how are you to open it or drive your team through without shoveling away the drift? With a gate like the one here illustrated, you simply pump a few times on the wagon-jack, and the gate



No matter how high the snow-drifts pile, you can swing open the gate with this contrivance and drive through

obligingly moves up out of the snow so you can swing it open.

First, be sure your gate does not sag. Then have a blacksmith make four eyes of strap-iron. Bolt two of these to the top and bottom of the hinged end of the gate with heavy bolts, and file out the inside of the eyes until they are smooth.

Set a length of 2½-in. iron pipe in the ground so that a part about half the height of the gate will project perpendicularly above ground. Then slide a length of 2-in. pipe inside the 2½-in. piece. The bottom should touch the ground and the top reach about 2 feet above the top edge of the gate.

Use the other two eyes to strap these pipes to a solid post about 4 in. from them. The bottom eye can be tapped and bolted to the pipe if desired, but let the upper pipe slide through the top eye.

Before assembling the pipes to the post the gate eyes should have been slipped over the pipes. See that they both swing about the pipes without binding.

Drill a hole through the 2-in. pipe just under the top eye on the gate, and run a long bolt through it. Run another bolt through the same pipe just above where it emerges from the lower pipe and in line with the fence, so it projects out between the gate and the post.

A study of the diagram will explain the construction, assembly, and manner of working.

When the snow is so deep the gate cannot be swung open, simply put a jack or lever under the lower projection bolt and raise the 2-in. pipe. The top bolt, bearing under the top eye of gate, carries the gate up with it so it can be swung open above the drift.—L. B. ROBBINS.

The Care and Operation of D. C. and A. C. Motors

MOTORS should be at rest when oil-wells are filled, to prevent accident and to avoid a false oil level, due to a certain amount of oil being carried up to the shaft and linings when the motor is in operation. Use a good grade of motor oil.

To Start Motors

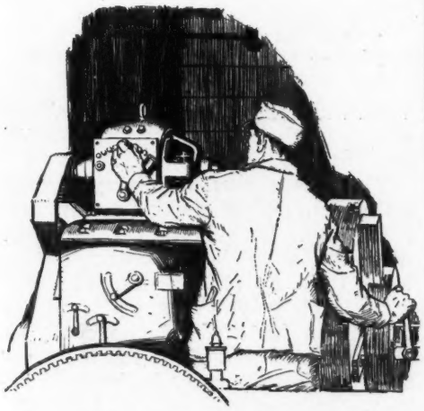
First, be sure that the rheostat arm is in the "off" position. Second, close the main switch (the line switch should always be either fully closed or fully open). Third, with hand-starting devices, move the lever of the starting device firmly on to the first contact; hold it there for two or three seconds, to allow motor armature to accelerate slowly; then move the rheostat lever from one contact to the next until it is in the last position, where the magnet will hold it.

To Stop Motors

First, open the main switch. Second, be sure the starting lever is returned to the "off" position by the time the motor stops.

If any of the contacts arc, they should be cleaned with sandpaper. See that the brushes move freely in the holders and at the same time make firm, even contact with the commutator. The commutator should be kept perfectly clean.

In case the commutator has become rough, prompt attention should be given to avoid undue sparking, heating, and similar troubles. The roughness may be removed by polishing the commutator with a piece of sandstone from which a segmental piece has been cut having the same radius as the commutator. Sandpaper may be used by pressing it against the surface of the commutator with a block of wood shaped like the sandstone mentioned. In both cases the commutator should be run at a high rate of speed during the polishing, and the sandpaper should be moved back and forth along the surface,



Do you know how to care intelligently for an electrical motor? Here is some common-sense advice

Dentists Now Urge

A New Teeth Cleaning Method

All Statements Approved by High Dental Authorities

Leading dentists all over America are urging the adoption of a film-removing tooth paste.

Millions of people have already proved it. In every circle nowadays you see white, glistening teeth. Ask about them and the owners will say, probably, that Pepsodent has done it.

By Fighting Film

Those results come from fighting film — that viscous film which ever forms on teeth. Most lack of luster is now traced to that, also most other tooth troubles.

Film clings to teeth, enters crevices and stays. The tooth brush does not end it. The ordinary tooth paste does not dissolve it. So much of it stays and hardens, until you have it taken off in the dentist's chair.

Film is what discolors — not the teeth. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. All these troubles have been constantly increasing for lack of a film combatant.

The Way is Found

Dental science, after years of searching, has found a way to fight film. Five years of clinical and laboratory tests have proved it beyond question.

For home use the method is embodied in a dentifrice called Pepsodent, made to meet every dental requirement. And to make it known quickly in every home, a 10-Day Tube is being sent to everyone who asks.

A Quick, Convincing Test

The Pepsodent results are evident and quick. A ten-day test will leave no doubt about them. And a book will tell the reason.

Pepsodent is based on pepsin, the digestant of albumin. The film is albuminous matter. The object of Pepsodent is to dissolve it, then to day by day combat it.

A new discovery makes this method possible. Pepsin must be activated, and the usual agent is an acid harmful to the teeth. But science has found a harmless activating method. Now active pepsin can be constantly applied, and forced into every hiding place of film.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how the teeth whiten as the fixed film disappears.

Look at your teeth now, then look in ten days. Let your own teeth decide between the old ways and the new. This is important. Cut out the coupon so you won't forget.

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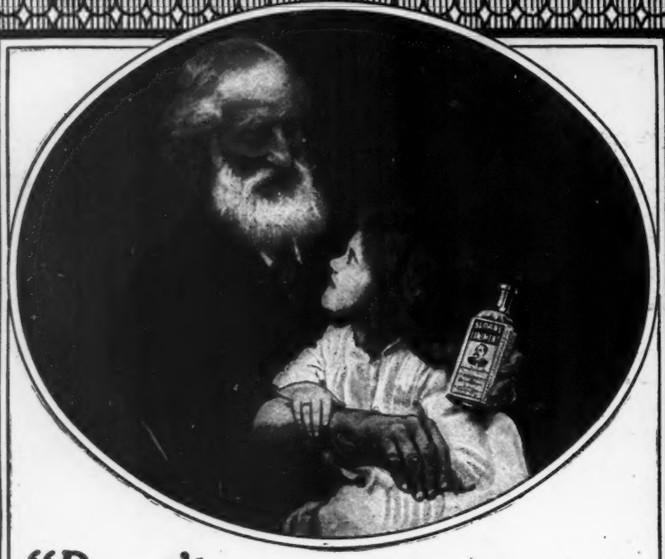

"Doesn't ***that feel better now, Grandpa?"***

Grandpa can tell her of a thousand and one times when Sloan's Liniment routed the pains and aches of Rheumatic Twinges, Sciatica, Neuralgia, Neuralgic Headache, Lumbago, Stiff Joints, Sore Muscles.

HE always keeps it handy for those sudden, unexpected attacks. Just as thousands of families keep it handy for strains, sprains, bruises, and all other external aches and pains.

Sloan's Liniment — promptly, without skin-stain or rubbing, *penetrates*, scatters the congestion, and produces a warm tingle of comforting relief.

Get a bottle at your druggist's today. Get the *largest* bottle — greatest economy in the long run. 35c, 70c, $1.40.

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Earn from $300 to $600 a month

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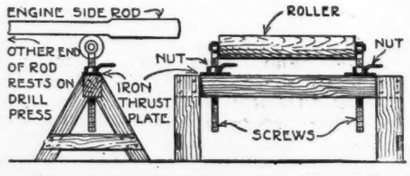
parallel to the shaft. Then carefully wipe off the commutator and brush surface to remove grit. Never use emery-cloth. If this treatment does not remedy the trouble, or if the commutator is in bad condition, call an electrician.

In the very small motors, such as those connected with adding-machines, washing-machines, etc., you will find in most cases grease-cups filled with vaseline for lubricating their bearings. They should be inspected at least once a month, and kept filled with this lubricant. The vaseline is fed to the shaft through a wick. The brushes should be taken out and cleaned occasionally.

A motor operating continuously at full load will heat up considerably. If the hand cannot be held against the heated part for longer than a minute, it is advisable to take temperature readings and report them to the manufacturer.

A Leveling Trestle for Use in Machine Work

IN the shop where I work a certain amount of work is done on engine side-rods, etc., which must be blocked and shimmed on the free end in order to level them. In order to overcome the necessity of hunting up blocks and shims of the proper size each time such



This apparatus saves man hire by making the work a one-man job; it is easy as well as inexpensive to make

work was done, a trestle was made, as shown in the diagram, which proved its worth on the first job.

The trestle was built very strong, its beam of a piece of oak 4 by 6 in. and 3 ft. long. Two holes 1 1/18 in. in diameter were bored through this beam 18 in. apart from the center and 9 in. each way. Two ¼-in. plates were then fastened on the beam to take up the thrust of the screws, these being made from two 1-in. bolts 12 in. long, threaded all the way, and the heads forged and drilled. Two wing-nuts and a roller were then made, the roller from a piece of 2-in. cold-rolled steel. The apparatus was then complete.—O. F. GERMAINE.

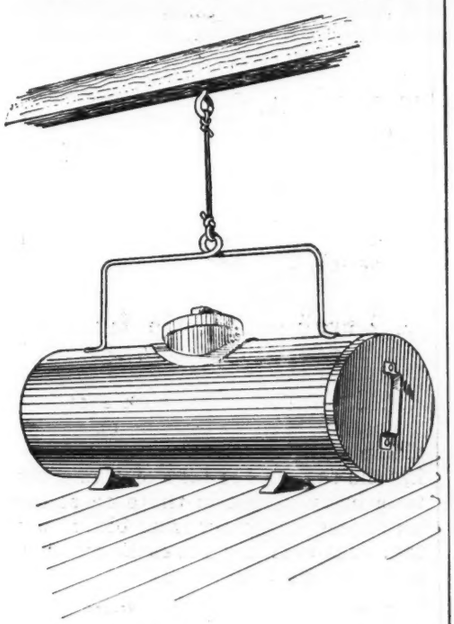
Make Yourself an Adjustable Swing Churn

CONSULT your tinsmith, follow the specifications as outlined by Miss L. Dorman, a farmerette of Mississippi, and the results will be a swing churn—a product that is at once new, sanitary, and a labor-saver. It is a homemade device, its durability

is measured in terms of half a lifetime, and the cost is negligible.

For a churn of two and one half gallons capacity, obtain a heavy quality of block tin and shape it in an 18-by-20-in. square. Place it on 2-in. legs, arrange a handle for each end as propellers, and carve a 6-in. opening through the top for pouring the cream.

The cover to the opening fits snugly on the inside, like an old-fashioned bucket lid. A substantial



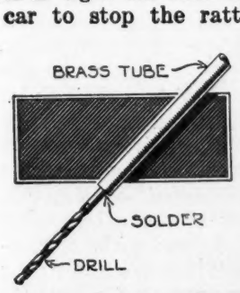
This easily made swing churn is merely shoved back and forth when it is filled with cream. It is quickly cleaned and keeps out all dust or dirt

wire handle is soldered at each end of the churn, with a ring in the center. One end of a cord is passed through the ring and the other fastened to another ring, or hook, in a beam overhead.

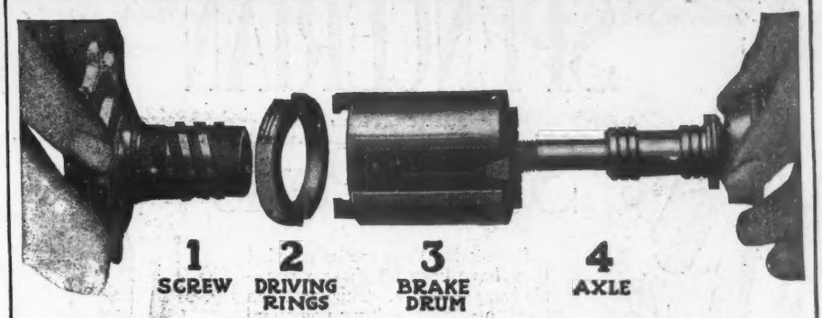
Ready for operation, the swinging device can be adjusted to any height. A small child can operate the churn, which is shoved back and forth. The sudden impact of the cream against the churn affords the friction for making the butter.—S. R. WINTERS.

Bore Difficult Holes with the Long Shank-Drill

HOW often have you tried to keep tight the bolts and nuts on your car to stop the rattle? When you tried to drill the bolt for a cotter-key, either the drill was too short or the chuck was in the way. Or, when you tried to lock the nuts on the cylinder-bolts, you could not get near them. Here is a way



If your drill doesn't reach down into that deep hole, a copper tube will help do the trick



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Back pedaling expands the 'brake drum' and forces the bronze 'brake shoes' against the *entire* inner steel surface of the hub. This checks and controls the speed of your bicycle.

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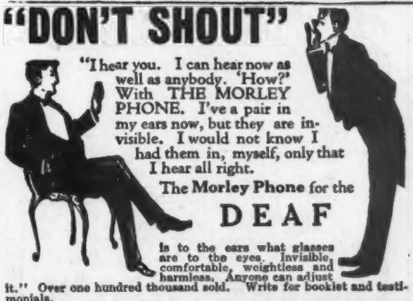

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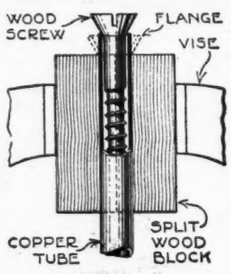
to solve these little difficulties. All you need is a piece of copper or brass tubing with an inside diameter equal to the outside diameter of the drill or a little larger. Sweat the drill into the tube by using either a torch or soldering-iron. Make it any length you want.—O. J. THIELHART.

Flanging a Copper Tube for Automobile Connections

AUTOMOBILE mechanics find it necessary to flange copper tubing to make connections for carburetors, vacuum feed systems, etc., and usually there is no equipment for doing this kind of work.

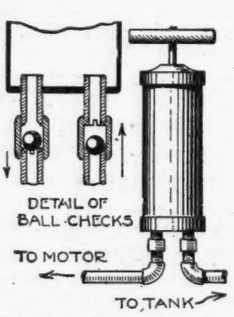
A block of wood is procured 2 in. square by 4 in. long. This is bored lengthwise in the center with a 5/16-in. drill, then cut centrally along the hole with a fine saw. This serves as a clamp for holding the tube in the jaws of a vise, the tube being placed in the bore of the block, one end projecting 1/8 in. at the top. An ordinary flat-head machine screw, with a body diameter that permits fitting loosely in the tube, is dropped into the tube, the screw then being tapped lightly with a hammer. At every blow the screw turns slightly, flaring the tube end.—R. L. PRINDLE.



Flanging a copper tube with a screw and wood block

Make an Oil-Pump from an Old Tire-Pump

THERE are times when one desires to force an extra amount of lubricating oil into the engine. This is impossible without an extra pump, and such a one is shown in the sketch. It is made from an old bicycle pump.



Here is a way to transform that old tire-pump into an oil-pump

Cut off the pump to within about 6 in. below the handle, refit the bottom cap, and tap it for two holes, one each side of the center. Fit two ball-check valves to these tapped holes. They should act in opposite directions. In this way oil drawn into the pump from the tank cannot be forced back into it, but will pass out of the other valve into the motor. Likewise the oil cannot be drawn back into the pump, but will be again drawn from the supply-tank. This pump is inexpensive and may pay for itself in a short time.—L. B. ROBBINS.

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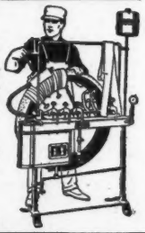

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Making a Refrigerator that Needs No Ice

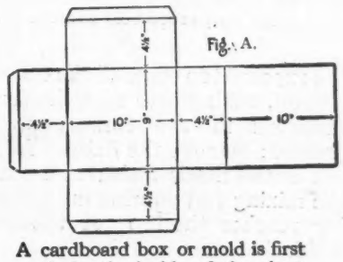
IF it were possible for you to visit an ancient Persian home you would be served with delightfully cold, pure water, in spite of the fact that your Persian host did not know what ice was.

This is accomplished by the use of a principle well known to the ancient Persians. Your host placed the water in an earthenware water jug, which being porous would become wet through. The dampness, coming in contact with the warm air outside, would cause evaporation on the outside of the vessel and the contents would become very cold.

You can use the same principle to keep the milk-bottle cold or to provide a cold drink of water. The apparatus consists of a small plaster-of-paris chest just large enough to contain two quart-size milk-bottles; it can be made by anyone who follows these instructions.

Inner and Outer Molds

Make a cardboard box or mold for the inside of the chest just 4½ by 9 by 10 in. (see Fig. A). This mold should be thick enough to hold the wet plaster in place without bending inwards. After laying out the card to the proper dimensions, cut out around the outlines and score lightly on the outside,



A cardboard box or mold is first made for the inside of the chest

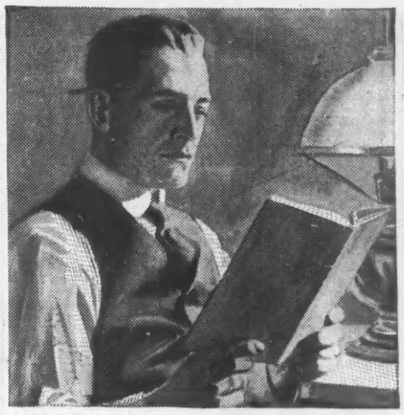
so that the corners will be straight. Bend into box shape and paste strips of paper over the open edges to prevent the plaster from getting inside the mold.

Now make an outside mold of wood (see Fig. 2), tying it down on the bottom board to keep the plaster from running out under the mold. Fasten this mold together with screws, so that you may take it apart without breaking your casting when complete. After you have marked a line 3 in. from the top all around the inside of the outside mold, you are ready to make the casting.

How to Handle the Plaster-of-Paris

Place the cardboard inside mold or core (Fig. 1) in the center of the outer mold (Fig. 2), resting on four blocks at the corners, about 1 in. square and just 1½ in. high. Use a flatiron or other weight on top of the inner mold to keep it from floating away when you pour the plaster.

Have on hand a good supply of



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..Catarrh	..Insomnia	..Poor Memory
..Asthma	..Heartweakness	..Rheumatism
..Obesity	..Short Wind	..Poor Circulation
..Headache	..Flat Feet	..Skin Disorders
..Thinness	..Constipation	..Despondency
..Rupture	..Biliousness	..Round Shoulders
..Neuritis	..Torpid Liver	..Lung Troubles
..Neuralgia	..Indigestion	..Increased Height
..Flat Chest		

Name.....

Age.....Occupation.....

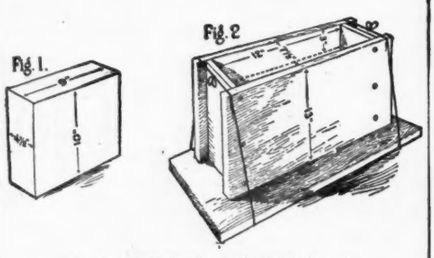
Street.....

City.....State.....

plaster-of-paris, because, once you begin to mix and pour the casting, you will find no time to get more, since it dries very quickly.

Fill a large mixing-bowl half full of water, then stir the plaster in a little at a time until the mixture is fairly heavy but will run freely; then, after making sure that the mold is perfectly level, begin to pour the wet plaster. Repeat the mixing and pouring until the plaster reaches the mark you have made 3 in. below the top of the outside mold.

The casting you have just made is the ice-box of your refrigerator. Let the casting stand until the plaster is dry (about two days, for safety); then with your countersink bit, or with the end of a knife-blade, bore out four shallow holes on the top edge of the casting in each corner, to serve as register knobs on the bottom edge of the cover when complete. Now, with a little butter or lard, grease thoroughly



At the left is the box folded. At the right the completed chest, which keeps food cold without ice

the exposed top edges of the casting all around, taking care that the four depressions in the corners are well greased; remove the flatiron from the top of the inside mold; and continue the mixing and pouring until the casting reaches the top of the outside mold.

When this new section or cover is thoroughly dry, carefully remove the outside mold, and with an 8-in. bit or gimlet bore two holes down through the center of the cover for ventilation.

If the edges of the chest were properly greased the two sections of the casting should come apart with little difficulty, and you can then remove the cardboard center mold by breaking it up.

Set the refrigerator in the sink and let a gentle stream of water run on it, inside and out, until it is wet through. This is all the "ice" required, and one wetting should be sufficient for several days, the precise number of which you will be able to judge by experience. Place the milk or water in bottles inside, fit the cover on snugly, and you will be surprised to find how cold they will keep.

The device will be found useful in hot weather to keep liquids and eatables from spoiling for it keeps them cool not ice-cold. It can also be made in different sizes to suit individual by changing the form of the mold. Its cost will be amply repaid by decreased ice bills.—MORTIMER TESSIER.

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Repairing a Steam Engine Under Difficulties

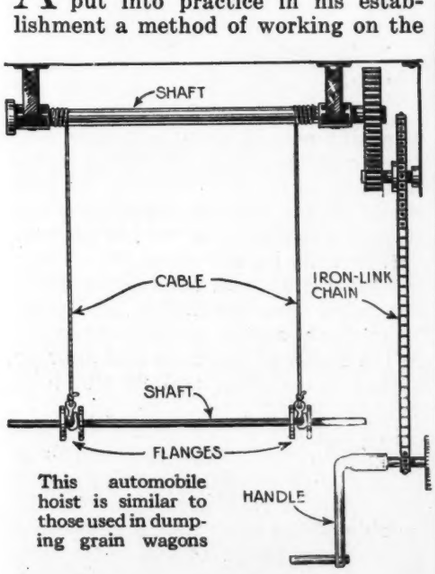
WHILE on a vacation in the Sierra Nevada mountains in California, I came upon a construction camp where the men were engaged in building a rock dam to impound the water from the winter snows for use in the gold-mines in the summertime. Their hoisting engine had broken down, and as the engineer was not a machinist, he was helpless.

I found that the connecting-rod was of the marine type, and that the two bolts on the crank end of the rod, which hold the crank brasses in place, were sheared off. This was probably due to starting the engine when there was water in the cylinder. The camp possessed a small forge, but no screw-cutting tools.

However, I determined to get the repair made somehow; so, after forging two new bolts, I clamped the threaded end of the broken bolt on to a new one, scratching each thread with the point of my knife to get the correct spacing. I then proceeded to cut the thread with a triangular saw file that happened to be in the tool-box of my automobile. By working carefully and filing at the pitch of the screw, I succeeded in threading two bolts in about four hours' time, and had the engine running again in less than six hours. The bolts were ¾ in. in diameter with about 1½ in. of thread.—M. L. LOWREY.

To Work on the Under Side of a Car

A WISCONSIN garage-owner has put into practice in his establishment a method of working on the



This automobile hoist is similar to those used in dumping grain wagons

under side of cars without having to get under them.

In order to do this he employs a hoist similar to that used for dumping grain wagons, with which he is able to stand the car on one end, or the other, to suit the particular job he has on hand at that time.

The hoist consists of a shaft geared back to a crank so that a load of

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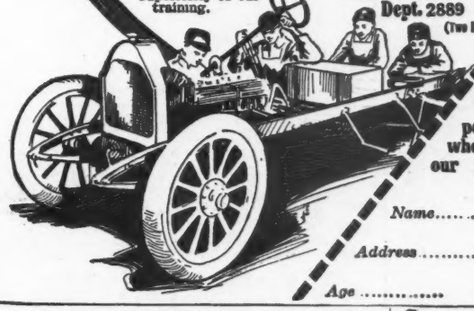

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Elmer Smiley, Albia, Ia., writes, "I have **sharpened** 22 lawn mowers today."—$22.00 daily earnings is some money.

E. W. McCormick says: "Have had "Ideal" only 15 days—**sharpened** 117 mowers, plenty of work ahead." That is making

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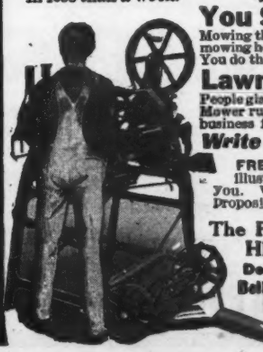

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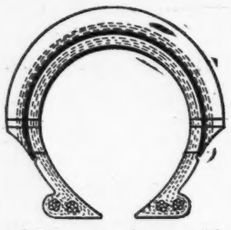
several tons can be easily lifted. Cables carrying hooks are wound upon the shaft as the crank is turned. A piece of 2-in. gas-pipe, padded and equipped with flanges, is slipped through the spokes of both front or both rear wheels as the case may be, and the hooks attached. Padding prevents the paint from being marred and flanges keep the hooks from sliding either way on the pipe.

The device is simple, durable, and very easy to install; and with any ordinary car may be hoisted to the desired position in three minutes. When the hoist is attached to the rear end of the car the car may be raised to an angle of ninety degrees. The front end may be lifted to an angle of sixty degrees or more, depending upon the shape of the rear fenders.—PAUL L. FETHERSON.

A Novel Way to Retread an Automobile Tire

ALTHOUGH many people retread their own tires the process is generally looked upon as a waste of time because the job is so often unsuccessful. The process here described has proved satisfactory, and by following it carefully a large amount of tire money will be saved.

Take a tire with a badly worn tread. It should have good fabric and show no signs of rim-cut. The rubber must be removed from the fabric to within 2½ in. of the bead. An old rasp will be found useful in removing the rubber. Rough up the fabric a bit to give a good hold for the cement.



Make use of your old tires and save money

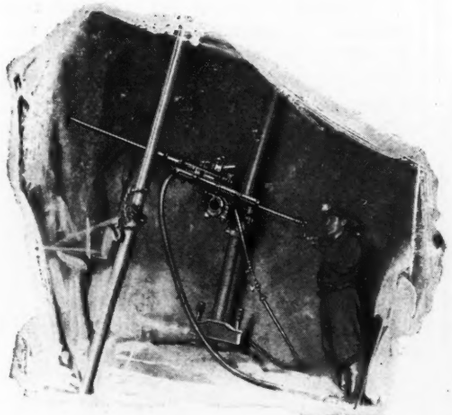
The tire should then be thoroughly dried out, since any remaining moisture will cause the tread to become loose. After this is done give the surface a coat of good rubber cement.

Now split an old inner tube along the inner side, and carefully wash it out with gasoline inside and out. Then apply a coat of rubber cement to the inside of the tube and another to the tire casing, and fit the tube over the casing.

Select a tire with a good tread and cut off the beads, wash the tires thoroughly with gasoline and dry them, and apply a coat of cement to the outside of the inner tube and another coat to the inside of the outer tire. Then fit the tire over the tube, and place both upon a wheel, pump up and allow to dry. You may then remove and sew it along the edges as shown in the sketch. In this way you can utilize old tires that would otherwise be thrown on the junk-pile. When they wear out the tire underneath is still brand-new. Try the suggestion—it will save you money.—S. E. GIBBS.

Tractor
on the Farm

The Drop Hammer in the Factory



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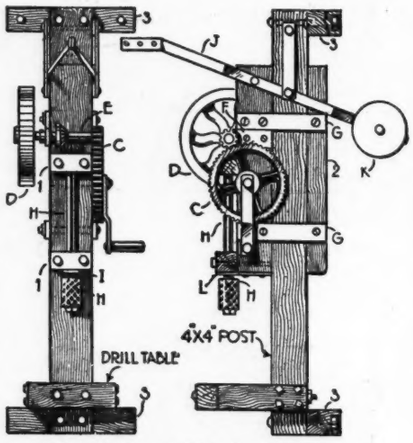
A Drill-Press and How to Make It

THE homemade drill-press illustrated herewith is one that will actually do the work of the manufactured article, drilling holes up to ¾ in. in diameter. It can be constructed by any one who possesses an elementary knowledge of the use of tools.

The greater part of the press is made of wood, well seasoned oak being the best for the purpose. All numbered parts in the illustrations are made of wood, but cast bearings may be substituted for l, l, if desired.

The motion block bearings are constructed of well seasoned oak. To this is bolted the two bearings l, l, with two 5¾-by-⅜-in. machine bolts, the nuts being set in pockets as shown at *H*. The bearing *E*, forged from ¾-in. iron, is also bolted to the motion block,



The whole machine is bolted to a strong post so that it will carry the motion block to its highest point

being countersunk into the wood at *A A*. At *B* a ¾-in. hole is bored into which is fitted a ¾-by-7-in. machined bolt to act as a bearing for the drive wheel *C*.

Shafting ¾ in. in diameter is used throughout. The gears, with the exception of *C*, are fastened to their respective shafts by means of 1-in. pins, riveted. The holes in the gears are countersunk. The flywheel *D* is fastened to shaft *E* with a ¼-in. pin, being only slightly riveted. The end thrust of shaft *E* is taken up by spacing washers placed between the hub of *D* and the arm of bearing *E*. The bearing blocks 1, 1 are drilled for shaft *B*, the hole being 1¼ in. in diameter. These holes are roughened and made larger in the center than at either end. A few pins of iron with rough heads are also driven into the walls of these holes. The shaft *E* is then put in place, lined up so that it is exactly perpendicular to the drilling, and molten babbitt poured into the bearings.

The four pieces *C* are now fastened to the motion block. These are made of ½-in. iron and are fastened to guide block 2. All parts subjected to the reciprocating motion of this block

should be carefully shod with ⅛-in. sheet iron which is fastened to the wood with wood screws, countersunk—or angle-irons may be put on all corners subjected to motion. This is not shown in the drawings.

Any standard drill chuck may be used at *H* or a chuck from an old carpenter's brace may be used; in fact this is to be preferred because square shank drills are much cheaper than other kinds.

Between chuck *H* and thrust bearing *I* are placed several machined spacing washers. The thrust bearing is fastened into place after shaft *I* is in position.

The drill is fed by means of a lever *J*, which is made of 3/16-in. iron in the shape shown. On the back end is placed a counter-balance *K* to restore the motion block to its original position after drilling.

The fulcrum rods *L* are made of ¾-in. iron about 9 in. long. There are two of these, one on each side, and they are fastened at the top end by a bolt, and so secured that they move freely as illustrated by the dotted lines. All the feed lever parts should be neatly adjusted, washers being used where spacing is necessary. The whole machine is bolted to a strong post 4 in. square by blocks 3-3. Counterbalance *K* is then fastened on 3 behind the plank, to which the machine is bolted so it will easily carry the motion block to its highest position.

The drilling table is strongly made from oak and is fastened to the drill post by six bolts. Under gear wheel *C* a large washer is placed and a suitable handle bolted on.

The gears used in the above-described machine were taken from an old washing-machine.—W. L. STEVENS.

Why It Is Your Automobile Radiator Boils

THERE are three principal causes for the boiling of the water in a motor radiator and the consequent necessity and annoyance of frequently replenishing it.

The fan belt slips, the pump does not work, or the ignition system is not correctly timed. If, after assuring yourself that the fan belt is tight and the pump works properly, the heating continues, you may be practically certain that the magneto is not timed right. The spark is too slow. It comes slightly after the point of maximum compression, with a resultant loss of speed and power, an excessive consumption of gasoline and rapid heating of the water in the cooling system.

Unless you have an instruction book describing very carefully the process of retiming an ignition system, you had better have this done by an expert at some garage. Like a skilled physician he can instinctively feel the "pulse" of your motor and diagnose its ills and cure.—FLOYD L. DARROW.

3¢ Worth of Miracle Motor-Gas Equals a Gallon of Gasoline

A Wonderful Chemical Discovery That Increases the Power of Gasoline Fully One-Third

Miracle Motor-Gas is a big money saver for the motorist. You will be surprised, then gratified at the way it multiplies the power of your gasoline. Hundreds of our customers who have made many tests tell us that Miracle Motor-Gas gives from 15 per cent to 40 per cent more mileage from every gallon of gasoline. Many claim even greater results than that.

Guaranteed Absolutely Harmless

If used according to directions Miracle Motor-Gas is guaranteed to increase mileage from 15 per cent to 40 per cent, eliminate and prevent carbon deposits, greatly reduce fuel costs and make engine run more smoothly.

We guarantee it to contain no acids, alkali, camphor, ether or other chemicals which could possibly injure any part of the motor or other mechanism of the finest car. We further guarantee to make good to any purchaser, any injury to his automobile caused through the use of Miracle Motor-Gas.

What Miracle Motor-Gas Will Do

One hundred Miracle Motor-Gas Tablets will make 100 gallons of gasoline do the work of 133 gallons; will give you an increased power and mileage the equivalent of 33 gallons of gasoline. Figuring on this basis, the following shows what a big saving can be made by using Miracle Motor-Gas Tablets:

If from 100 gallons of gasoline you get 1500 miles, the addition of 100 Miracle Motor-Gas tablets will increase that mileage to 2000 miles. Think of it—500 miles for one dollar.

And here's the big thing—Miracle Motor-Gas contains no acids, alkali, camphor, ether or any other chemicals that could possibly injure any part or parts of the motor or other mechanism.

It will eliminate carbon and make your motor run better in every way. Miracle Motor-Gas is needed the year 'round, but it is especially needed in winter for it insures easier starting and quicker pick up.

Thousands of Motorists Are Using Miracle Motor-Gas

Motorists in every section of the country have put Miracle Motor-Gas to the severest of tests with the result that they are re-ordering it and recommending it to their motorist friends.

Our files are actually crowded with unsolicited letters endorsing this great discovery. Many of them state our claims are far too modest; some going as far as to say that Miracle Motor-Gas saves them 50 per cent in gasoline.

After one trial you will be just as enthusiastic as the thousands of other motorists. You are losing money every day you delay the trial.

What Users Say About Miracle Motor-Gas

"We can recommend it to do all you claim for it. We are saving on gasoline bills fully 40 per cent and believe we can do better than that as the carbon is all gone; that alone is worth more than the cost to say nothing of the additional power and speed we get." J. S. NEELAND.

"I was very doubtful about the ability of your Miracle Motor-Gas to do what you said it would do. After using it I find the car works much smoother, the amount of gasoline is very much less and the carbon deposits in the engine are a thing of the past, which fact alone more than pays the cost of your product. As you know, I was a hard customer to convince but I have been thoroughly convinced and satisfied." DR. D. W. MCKENNA.

"I have tried Miracle Motor-Gas in two makes of automobiles with the following results: An increase of mileage with the Hupmobile of 45 per cent; Studebaker an increase of 44 per cent, and carbon was entirely eliminated from both machines." H. E. DAUB.

Easy to Sell! Profits Come Fast! One Man Made $210 in One Day

Once you get started selling Motor-Gas you will be surprised to find how easy it sells. Just show our Guarantee to some auto owner and ask what he would give for a product that would do what we guarantee it to do. Read again these letters from users,—they tell the story. We have hundreds more just like them. As soon as auto owners find what Miracle Motor-Gas will do, they scramble to get a supply. You don't have to sell it. You only need to convince a few—the others will follow. Sales come so fast that you can't help but make money. One agent felt like pinching his own arm to see if it was really himself who was making so much money. It isn't at all unusual for our men to make $10, $25 and $50 per day. Some do better than that.

These are extracts from actual letters received from sales agents. They tell the story better than we can. Here's what O. V. Darling wrote us: "Made a test of Miracle Motor-Gas today on a 103-mile trip. Had two Fords. The one with Miracle-Gas used only 3½ gallons of gasoline; the one without Miracle-Gas used 7 gallons." As a result of this test he sold Miracle Motor-Gas like hot cakes. In one day he sold enough to make a clean profit of $210. We have his letter to that effect.

Next comes this letter from Dave Isom: "My whole heart and soul are in this work. The Commercial Club of 4,000 members is boosting for me. Everyone is well pleased. Have two more men working for me Send me 800 more packages by express. I can't afford to be waiting for goods. Sold 90 packages yesterday." (That's over $60 profit.)

Agents Wanted Everywhere—300% Profit

One of the greatest money-making opportunities ever dreamed of is offered you right now. Live, hustling sales agents are wanted to sell Miracle Motor-Gas in every town and country of the United States. Think of the millions of car owners and every one a good prospect.

Practically every auto driver will buy when once you have explained what Miracle Motor-Gas will do. It is one of the biggest money-makers you can find. Your field is unlimited. There are thousands of autos all around you and you can help to make every one of them run more efficiently with Miracle Motor-Gas.

GET BUSY! DON'T WAIT!

Don't make the mistake of being a doubter and losing the opportunity. Our guarantee protects you. Or, better still, if you order two packages at the 50c trial price, and after testing them you aren't satisfied, send back the unused goods and get your dollar back. Miracle Motor-Gas is a proven proposition. It has demonstrated what it will do and now we want hundreds more good live agents to sell it. So get busy—get your oder to us at once and tell us what territory you want. But you'll have to act quickly. Better write us by return mail. Wire if you want terms for exclusive rights in your State.

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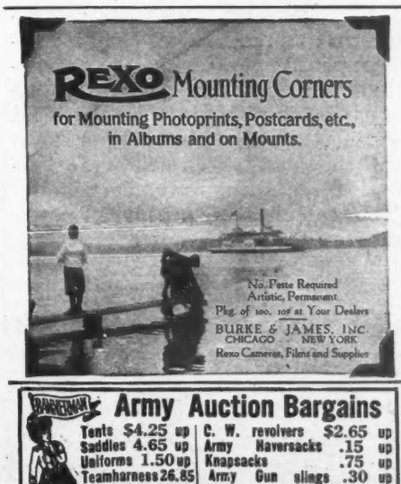
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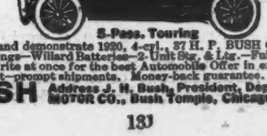

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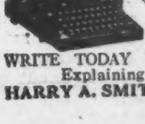

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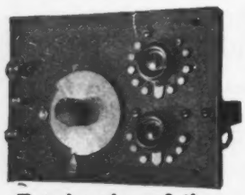
For the Radio Experimenter

A Simple Undamped-Wave Receiving Set for the Amateur

WITH the increasing number of undamped stations comes a desire on the part of every radio amateur for a set suitable for continuous wave reception. But the cost of a long-wave coupler and several variable condensers usually puts this out of the possibilities of the average radio experimenter. Here, however, is a set inexpensive as to first cost, and requiring but one inductance and one variable condenser.



Exterior view of the receiving set complete. All parts homemade

The core for the inductance is turned out of hard wood to the dimensions shown in Fig. 1. It is then wound with 1,000 turns of No. 32 single-cotton-covered wire. Two hundred turns are wound in the first slot, taps being taken off at every twenty turns. Eight hundred turns are then wound in the two remaining slots (400 turns per slot) with taps at every 100 turns.

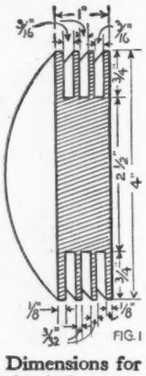


FIG. 1

Dimensions for the inductance coil of the set

The first set of taps are connected to the eleven contact studs of the switch represented by the lower of the three arrows in Fig. 2. The other sets of taps (those of 100 turns) are connected with the nine studs of the middle arrow. The winding should be given a layer of tape, and shellac used freely on all parts.

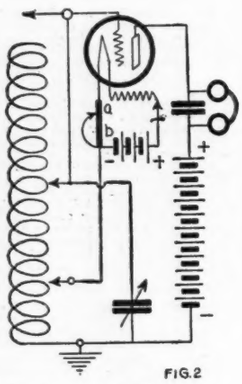


FIG. 2

Wiring diagram used in hooking up the parts

The diagram of connections is given in Fig. 2. The coupling between the plate and grid circuits is controlled by the two arrows just mentioned. The variable condenser determines the frequency of the local oscillations. It should be of the 43-plate type, and have a capacity of .00095 or .001 Mfd. Note that no grid condenser is used.

The grid is held at a definite negative potential by the resistance drop over "ab." This is a short strip of German silver wire whose length is varied until a position is found for best oscillation. Once made, this adjustment is permanent for a given vacuum tube. The inductance and condenser may be mounted in a small case and used with a purchased audion cabinet. The front board of such a case is shown in the illustrations herewith. All the materials used are easily within the reach of any amateur. At no place is the construction difficult nor the making of the various parts at all complicated. By reading the foregoing and carefully studying each diagram and illustration everything will become clear and the radio amateur will have no trouble in either constructing or wiring it together.—E. J. STERBA.

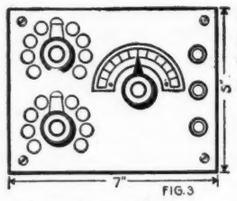


FIG. 3

Dimensions of the front panel as actually made

Clearing Up the Radio Patent Situation

ANNOUNCEMENT has recently been made that the Marconi Company and the radio interests of the General Electric Company have been combined in a new organization to be known as the "Radio Corporation of America."

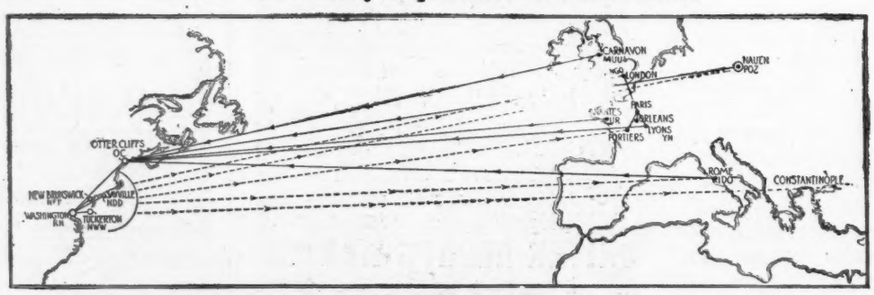
This means that the patents of both will be utilized to the limit. The Marconi Company owns the Fleming valve patent and others of value, while the General Electric Company has done a great deal of work on vacuum tubes and related apparatus. It has also developed the Alexanderson high-frequency alternator, a contrivance originally fathered by Fessenden.

One of the principal reasons back of the General-Electric-Marconi merger was the fact that about 18 per cent of the Marconi's capital stock was owned in England. The Radio Corporation now acquires that stock, along with other assets, making the new company an all-American concern.

The Western Electric Company has acquired de Forest patents, and has many of its own. Thus these two concerns and the International Radio-telegraph Company, which is a patent-holding organization, promise to be the three big rivals in the radio field very shortly. The Navy Department owns the Federal Electric's arc system, in itself a very valuable holding.

The complicated patent situation that grew out of the war is gradually sorting itself out.

How the Navy Operates Its Stations



The black lines show messages coming from Europe to the Otter Cliffs, Maine, receiving station. Messages are relayed over and wires to Washington by automatic machines. Washington replies by working the Sayville, New Brunswick, or Tuckerton stations through remote control. In this way the whole situation is under instantaneous control of the Washington operators

A World-Wide Experiment in Radio Transmission

THE eclipse of the sun by the moon on May 29, 1919, offered an unusual chance to study the effect of daylight and darkness on the intensity of radio signals. The British Association of Science arranged for certain stations to transmit and others to receive.

It appears that on the whole transmission was best just before, or during, the passage of the moon's shadow between the receiving station and the transmitting station. The moon's shadow traveled from South America at sunrise to the eastern coast of Africa at sunset, moving with enormous speed near the ends of its path.

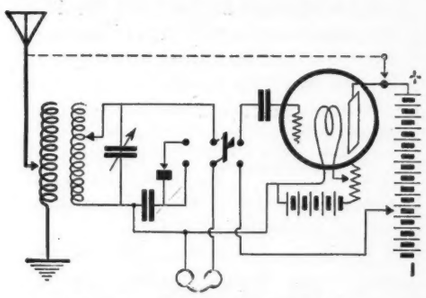
The most striking results were obtained by the French stations of Meudon and Rousillon, near Lyons, which could hear Ascension only while the eclipse was in progress.

Switch from Valve to Crystal at Will

A SIMPLE and efficient method of connecting the receiving tuner to either a valve or crystal detector requires but one switch for the operation, enabling a radio experimenter to have both types of detector in service, using a crystal for general work, and keeping the valve for more important receiving.

Ordinarily this idea necessitates the use of two or more switches, or, where one switch may have been used, causes some loss through dead-end effects.

The switch for the proposed circuit may be of the ordinary double-pole, double-throw type, as shown in the diagram. Preferably, though, it is of



Experimenters possessing both a crystal and tube will find this circuit a very convenient one

the kind known as a "pole-changer," as this may be built on the front of the receiving cabinet in a space about an inch square.

The "pole-changer" has two levers, connected by an insulating bridge carrying the handle. At the rear are two contacts, each connected to one of the levers. Each lever slides over two contacts at the front. These can be made of six old-type switch points, two small strips of brass, and a piece of hard rubber or bakelite (for the insulating bridge and handle).

The whole is then set on the front board of the cabinet with all connections completed on the rear of the board.

For continuous wave receiving on the valve, all that is necessary is to run a lead from the "aerial" post of the tuner to the plate lead—producing the well known Chambers circuit. By having a small single-pole switch placed as close to the plate lead of the valve as possible, undamped waves up to the full wave-length of the tuner may be received when this switch is closed. The position of this added lead is shown by the dotted line in the drawing.

A cabinet receiving set, equipped with valve and crystal detectors, using this circuit makes an ideal receiving outfit. Amplifying valves may be added, as in other valve circuits, and on the crystal side other crystals or a potentiometer may be connected. Radio experimenters in general may find other advantages.—GEO. A. WOLF and CHARLES E. PEARCE.

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Know the Electron—You Meet It Every Day in Radio

THE following are some notes on the electron taken from a chapter on that subject in a newly published book, "Realities of Modern Science" (MacMillan & Co.), by John Mills, a scientist who has written much on this and related highly technical subjects. Radio students will do well to read the entire book, as it correlates and makes understandable many laws and theories too often thought unrelated. Especially is the part on the electron worthy of attention. Electron theory is entering into an increased number of phases of radio in these times.—EDITOR.

IN finding how the matter of the universe is composed, scientists have at last reached the electron. In terms of it they can explain fairly well everything else, or at least there is promise that ultimately everything else will be so explained.

That the electrons are really mere specks in this universe of ether we realize readily from the statement that the radius of an electron is probably not larger than 2x10-13 cm. and that of a hydrogen atom is about 2x10-8 cm. The whole atom is perhaps one hundred thousand times as large in diameter as the electron. In other words, the radius of the electron is about as large, compared to the radius of the atom, as is the radius of our earth as compared to the orbit in which it travels around the sun.

In the case of atoms there are two ways in which electrons may be obtained. In the first case we may jar electrons loose from the atom. In the second case the electron may be thrown off by some disturbance having its origin in the atom itself. In this second case we call the substance "radioactive." Of such substances radium, discovered in 1897 by Monsieur and Madame Curie, is the best example. Other radioactive substances are uranium, thorium, actinium, and polonium. The atoms of such substances appear to be disrupting; not that all of them do so at once, but that of a bit of such a substance some of the atoms are always breaking down in this way. In such a breakdown electrons are shot out or other changes take place, and the result is new elements. Radium is believed to be a product due to the disintegration of uranium, and this may later be found true of the other radioactive elements.

Uranium, which is the heaviest known atom, has at least ninety-two electrons; that is, it has ninety-two electrons exclusive of any that may be contained in the nucleus, the construction of which we are about to consider. Between hydrogen, with only one electron, and the unstable uranium, with its ninety-two, lie all the possible elements. If one considers that an atom must have a whole number of electrons, it will appear that the other eighty-four known elements may fit in between hydrogen and uranium and still leave six yet to be discovered.

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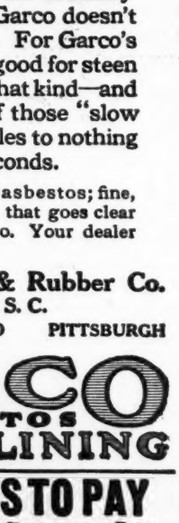

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The terms "Negative and Positive Electricity" were introduced by Benjamin Franklin about 1756, long before the electron was known, for our knowledge of the latter has all developed since Roentgen's discovery in 1895 of X-rays. The reader probably knows about X-rays as a means of taking pictures of bone or teeth for surgical diagnosis. In Franklin's time it was known that if a glass rod is rubbed with silk it is electrified; that is, it acquires the ability to attract light particles, as bits of paper or pith balls. Two pith balls electrified by contact with the rod are found to repel each other. On the other hand, a rod of sealing-wax that has been electrified by rubbing it with cat's fur will produce effects similar to those of the glass rod. But there is an important difference. A pith ball charged by the glass rod and one charged by the sealing-wax will attract each other. These phenomena may be summarized in a simple law, namely, like electricities repel and unlike attract. To the electricity of the glass rod Franklin gave the name "positive" and to that of the sealing-wax, the name "negative." However charges of electricity are produced today, we still use these names.

Returning to our consideration of the atom, we may now summarize as follows: (1) the normal state of an atom is uncharged; (2) the atom consists of a number of electrons, and a nucleus which has a positive charge just equal to the negative electricity of the electrons; (3) the operation of charging a body with electricity consists in causing either an excess or a deficiency in the number of electrons in the body.

Commonly Accepted Evidence

The nucleus attracts the electrons, and they are in general very firmly held in the atomic radius. But why doesn't the attraction that exists between the positive nucleus and the negative electrons draw them together? To this question the scientist has as yet been unable to obtain an entirely satisfactory answer. For this and other questions we must await either further theories or more experimental evidence. The statements, however, that we have so far made as to the nature of the atom are supported by experimental evidence and are commonly accepted.

The nucleus we recognize as positive electricity; but we mean thereby merely that it has an excess of positive electricity over any negative which it may also include. In fact, there is evidence that the nucleus itself contains some electrons. In the case of radioactive substances we find that electrons are shot off, and also atoms that we recognize to be helium. Helium is a light monatomic gas, twice as heavy as diatomic hydrogen. Its atom consists of a nucleus and two electrons.

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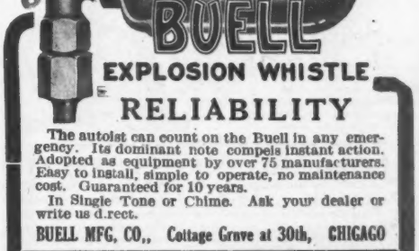

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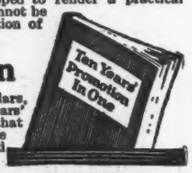

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The question of how the electrons of an atom group themselves under the action of their mutually repellent forces and the attraction of the nucleus is a difficult problem of mathematical physics. An interesting study has been made, however, of the manner in which a number of similar particles, which repel each other, would group themselves in a plane, under the action of a centrally located source of attraction.

In this experiment a number of small magnetic needles were first mounted vertically through small cork and thus floated on the surface of a vessel of water. Similar poles of the needles projected upward through the corks. A long magnet was suspended vertically above the vessel, so that a pole of opposite character to those of the needles might act as a center of attraction.

It was discovered that the configurations into which the floating poles grouped themselves depended upon their number. Thus three poles placed themselves at the corners of an equilateral triangle, the center of which was just below the attracting magnet. Similarly four magnets group at the corners of a square and five at the vertices of a regular pentagon.

When six magnets enter into the configuration, one goes to the center, immediately below the pole of the large magnet, the other five forming a pentagon. With seven and eight, similar figures are formed with one magnet at the center. With nine there are two in the center and seven in the outside ring. With ten or eleven there is an inner triangle and an outer ring of either seven or eight.

The number in the center increases until, when the total is fourteen, there is a pentagon inside and a ring of nine outside. In other words, as the number entering into the configuration is increased, certain arrangements recur. When the number is increased to fifteen, there is an outer ring of nine, an inside ring of five, and in the center of this a single magnet. As the number of magnets increases certain configurations appear more or less periodically, that is to say, at definite intervals.

It is reasonable, therefore, to expect, as prominent scientists have done, that, whatever the positive nucleus of the atom may be, atoms differing in their compositions by definite numbers of electrons may, in part, have similar configurations for their electrons.

In so far as the electron configuration, as well as the number, determines the characteristics, such atoms should have certain similarities in chemical properties. If a list is made of atoms in the order of the number of electrons they contain, those of similar properties might be expected to occur periodically in the list.

Win a $500 Scholarship

To encourage schools to make practical application of their class work and to popularize science, Popular Science Monthly will at the end of this school year, award 10 scholarships of $500 each to high school students.

Entrance Date Extended to April 1, 1920

Because so many ambitious students who wish to enter this contest did not get their names in on February 1, Popular Science Monthly has decided to extend the date for entries for these scholarships to April 1,1920.

Conditions

The following are the conditions for winning one of these scholarships:

1.—These Scholarships are open to Seniors in all High Schools and Private Schools in the United States.

2.—Names of Candidates, giving their school and their home address, must be mailed to Scholarship Committee, Popular Science Monthly, 225 West 39th Street, New York City, by the principal or headmaster of the school on or before April 1, 1920.

3.—The Scholarships will be awarded to the candidates passing the best examination on the important new scientific inventions and discoveries which have been outlined in the Popular Science Monthly. The examination will be given in the candidate's own school during the last week in May, 1920.

4.—The questions will be based on the topics in the Teachers' Service Sheets of Popular Science Monthly for the months of December, 1919, to and including June, 1920. These Service Sheets are furnished free to Science teachers.

5.—The examination papers will be sent to the Principal of every school where there are pupils to compete. The papers will be sent in a sealed envelope which must be opened in the presence of the candidates.

6.—The $5000 will be divided into ten Scholarships of $500 each. One Scholarship of $500 will be awarded to one student in each of the following groups of States:

New England Group: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut.

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7.—The Popular Science Monthly reserves the right to publish the answers together with the names and photographs of the winners of these Scholarships.

8.—Winners may select any College or University they wish to attend.

Ask your principal to send in your name to-day

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Popular Science Monthly
225 West 39th Street New York

How to Locate Instantly a Particular Drill

AMONG the labor-saving tools in my collection is a unique drill-case which at any moment locates the desired drill, yet when closed will not allow the drills to spill.

I first obtained a steel collar about half an inch wide and having an inside diameter of approximately 3 in. This was cut from a steel tube having a thickness of about 1/16 in. The collar was rough, and by means of a buffing wheel was soon brought to a polished surface. Measuring the outside circumference accurately and dividing the result by 20, I used a set of protractors, scratched the divisions, and stenciled the figures, using a steel punch and a piece of round iron about 2½ in. in diameter clamped

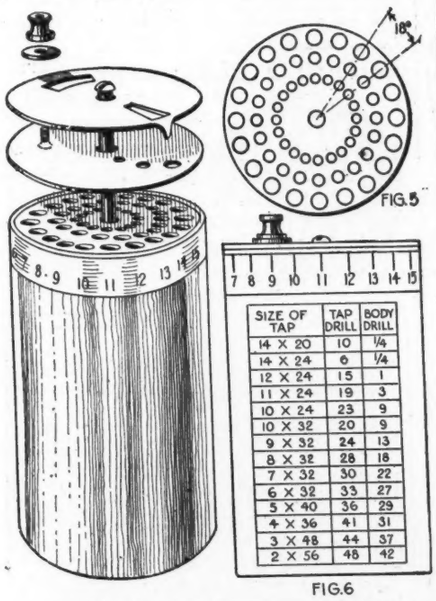

FIG. 5

SIZE OF TAP	TAP DRILL	BODY DRILL
14 X 20	10	¼
14 X 24	6	¼
12 X 24	15	1
11 X 24	19	3
10 X 24	23	9
10 X 32	20	9
9 X 32	24	13
8 X 32	28	18
7 X 32	30	22
6 X 32	33	27
5 X 40	36	29
4 X 36	41	31
3 X 48	44	37
2 X 56	48	42

FIG. 6

With this contrivance you can easily locate and take out the special drill needed for the particular work on hand

in a vise. The divisions were numbered from 1 to 20 inclusive. (See Fig. 1.)

Next I secured a piece of hardwood 3½ in. square by 5 in. long, and, centering it in the lathe, turned down one end for ½ in., so that the collar had to be forced or driven on. Then I turned the rest of the block down to the same outside diameter as the collar.

With the collar end down, I drilled a ½-in. hole about ½ in. deep in the center of the bottom of the block. Reversing the block, I drilled a hole with a No. 9 drill all the way through, the hole coming out in the center of the ½-in. hole previously drilled. (See Fig. 2.)

Out of 1/16-in. brass I cut two disks (as shown in Figs. 3 and 5). The cut shows the size of holes to drill and gives the dimensions. The three holes of different sizes on the disk in Fig. 3 should be counter-sunk on the top, and the one hole opposite, after being tapped, counter-sunk on the bottom.

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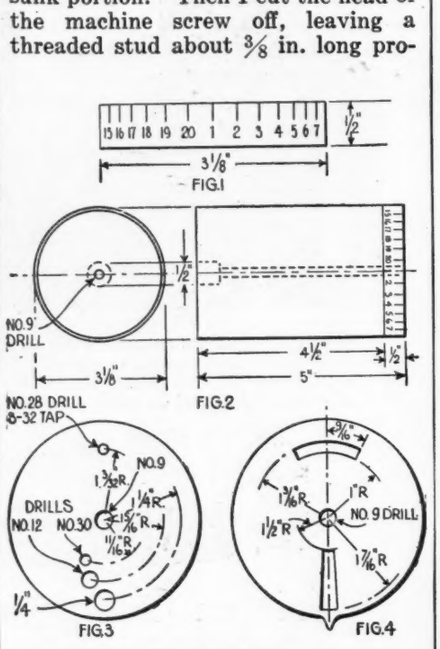
Into this latter hole I screwed the threaded end of an 8/32-by-¼-in. machine screw, and, turning the disk over, headed the end into the countersunk portion. Then I cut the head of the machine screw off, leaving a threaded stud about ⅜ in. long pro-



Showing how the drill-case is constructed, and just how it permits you to determine where a certain drill is located

jecting upright from the disk. To cut the two slots shown in Fig. 4, I drilled a number of holes and filed them out.

I then made a paper disk as shown (page 137), the dimensions from the center and the size of drills being the same as the bottom three holes in Fig. 3, and glued to the collar end of the block, being careful that the outside circle of large holes exactly coincided with the numbered divisions on the collar.

Placing it on a drill-press so as to obtain perfectly straight holes, I drilled the holes as shown in Fig. 5, being careful that the drill always went straight in the center of each hole and was not influenced by the grain in the wood.

If, however, the wood is of such grain that the drills will not run straight, paste the paper template on a small piece of brass plate and drill the holes, afterward using the brass template to guide the drills in the wooden block.

I placed a 10-by-5-in. round-headed machine screw through the center hole in the disk of Fig. 4, through the disk of Fig. 3, and down through the collar end of the block. A plain washer, a lock washer, and a nut are applied, and the end of the machine screw slightly headed over, so that the nut will not come off.

On the threaded stud of Fig. 3 now projecting through the disk of Fig. 4, I placed an 8/32-in. copper washer and a little knurled thumb-nut taken from the terminal of a dry-cell battery. The sliding of the top disk on the other disk allowed the three different size

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The judges decided that Scout Peirce's contest letter contained the sixteen best uses for the Auto-Wheel Coaster.

His Prize is the Auto-Wheel Coaster Itself.

The Other Prizes Were Awarded as Follows:

2nd. Tent, Henry Jacobs, 37 Watkins St., Brooklyn, N. Y.
3rd. Poncho, Frederick M. Folger, - - - - Easley, S. C.
4th. Fleetwing Racer, Jas. O. Pierce, - West Plains, Mo.
5th. Camera, E. B. Roensch, Dooley Bldg., Houston, Tex.
6th. Mess Kit, W. Hayward, 603 Cross St., Ypsilanti, Mich.
7th. Flashlight, Jas. A. Bishop, Route 12, Knoxville, Tenn.
8th. Knife, Arthur Rick, 223 Mariposa St., Syracuse, N.Y.
9th. Scout Axe, Joseph Gerend, Box 76, S. Kaukauna, Wis.
10th. Watch, Albert Schulte, - - Box 364, Houghton, Mich.
11th. 3-Coin Bank, Stuart Demarest, - Roselle Park, N. J.
12th. Scout Compass, Charles E. Brady, - - Glen Ellyn, Ill.

There will be several more Auto-Wheel contests this year. Watch for the announcements. Get the Auto-Wheel Booklet now. Send us the names of three local coaster dealers, mentioning which one handles Auto-Wheel. We'll send you a handsome *Felt Pennant FREE*, and our attractive booklet. Ask us about the Auto-Wheel Clubs—how to get special Caps for the members.

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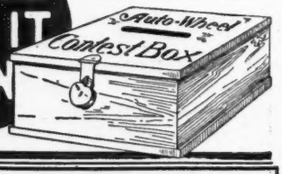

A-10 Wireless MESCO Manual A-10

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holes to appear in the slot of the top disk. Thus, if I want any drill from 1 to 20 inclusive, I set the disk so that the large hole appears and turn the pointer located on the top disk to the desired number on the collar. To obtain any drill between 21 and 40 inclusive—as for example No. 36—I subtract 20 from the number, and with the middle hole set in the slot turn the pointer to No. 16. The process for obtaining drills from 41 to 60 is identical, with the exception of using the smallest hole and subtracting 40.

The disks may be set so that none of the holes will appear and thus will be locked.

The assembled instrument is shown in Fig. 6. and the table of drills for a given tap may be stenciled on the wooden surface of the block.

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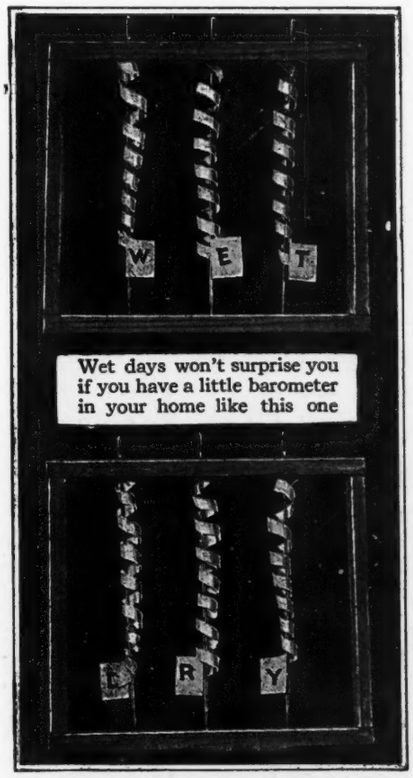

Wet days won't surprise you if you have a little barometer in your home like this one

frame. Around these are twisted three spirals of metal foil, fastened at the top but free at the bottom.

At the extremity of each is fastened a small square of paper. On one side of these is the word "Wet" and on the other side "Dry."

On a dry day the instrument is set to read "Dry." When rain is in the air the humidity of the atmosphere twists the tinfoil and turns the squares of paper so that they read "Wet."—M. JOHNSON.

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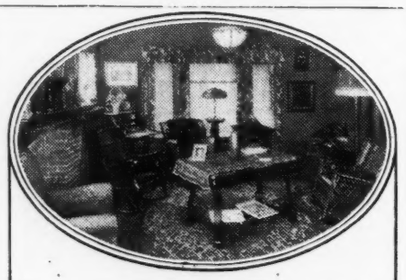

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Managing Difficult Electrical Installations

ELECTRICIANS sometimes encounter worrisome problems in suiting the whims of their customers. A wireman was called upon to wire up a room in which the lamps and wires were all in place but not connected, because no electrician had been able to satisfy the customer's desire to have two lamps on each of two circuits fed through single-pole switches from a three-wire service, with no more than two wires at any part of the room except at the entrance. The wireman finally evolved the scheme shown in Fig. 1.

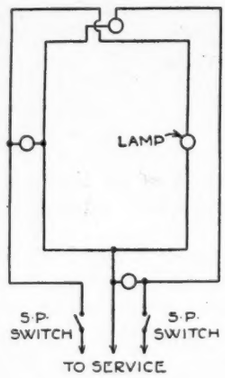

Fig. 1 shows how two lamps were wired on each of two circuits

Another man had four lamps in his stairway, located one at each of the four landings, which he wanted connected so that all of the lamps could be lighted or extinguished from any one of the switches located one at each of the four floors. How the electrician connected them is shown in Fig. 2. These are only two examples of the sort of thing electricians are up against every day. Therefore a man who follows this trade should have the faculty of resourcefulness.—FRANK GILLOOLY.

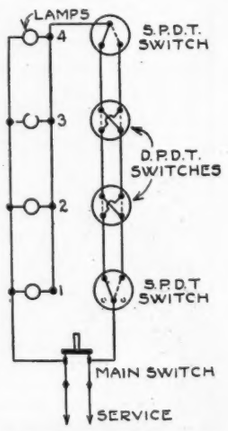

Fig. 2. How four lamps were extinguished from each of four floors

How to Use the Furnace for Cooking

MEALS are usually cooked in the kitchen range, and the furnace is used for heating; but by the following method it is possible to cook a great part of a dinner without any help from the kitchen fire, thus saving fuel and lightening the coal bill, or the gas bill, if your range is fed by gas.

A sheet-iron box, made to fit the opening of the furnace door, will utilize the space upon the hearth that would otherwise go to waste.

The back of this oven should project a few inches over the inner edge of the hearth, so as to receive the full benefit of the heat. As can be seen

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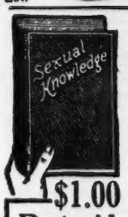

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from the illustration, the bottom of the oven is raised slightly above the hearth, which permits the heat to circulate beneath the under side. Slides should also be so arranged that a grilled

By setting the tray in the mouth of the furnace you can use the heat for cooking

shelf can be admitted, thus utilizing both the upper and the lower parts. Handles should be attached on either side to assist in removing the oven when warm.

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Be careful when inserting tubes.

Avoid sudden stops, quick starts and skidding.

Keep the front wheels in alinement.

Use talc in the casing, but don't use too much.

Avoid ruts and save the side walls.

Don't drive in car tracks.

Apply chains properly and use them only when necessary.

Avoid sharp obstructions.

Remove grease, oil and acids from your tires at once by using a cloth moistened in gasoline.

Examine clincher rims occasionally for irregularities and rust.

Prevent damage from rust by using graphite.

Carry spare tubes in a bag.

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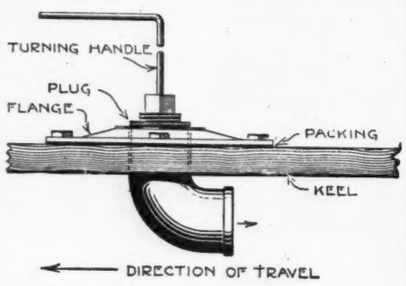


Get rid of that tin-can bailing habit by installing this automatic boat-pump in your launch; it never fails

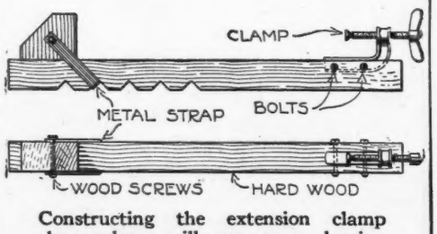
Bore a hole in the keel, and thread in an elbow as shown, directing the horizontal opening toward the stern. You can render the seams water-tight with a flange bolted to the inside of the keel-piece. Fit a plug with a turning handle, and the deed is done.

After the boat is in motion unscrew the plug, and the water in the bilge will be drawn out, due to action similar to that in a siphon. Then close it again with the plug before stopping. This is simple and will never fail.—WINDSOR CROWELL.

An Extension Clamp for the Amateur Carpenter

AN extension clamp is desired by every home carpenter, but he has been prevented from buying it on account of its high cost.

One is easily made, however, from a broken C clamp. With this, all that is needed are two pieces of hardwood, two 3/8-in. bolts, two head screws, and a piece of metal strap. By following the accompanying illustration the clamp can be made in a very short time and will give good service for years.



Constructing the extension clamp shown here will save you buying the expensive manufactured article

Dimensions cannot be given, since the clamps come in assorted sizes; but they are unnecessary, for the clamp itself can be used and the rest of the contrivance may be made in proportion.—O. J. THIELHART.

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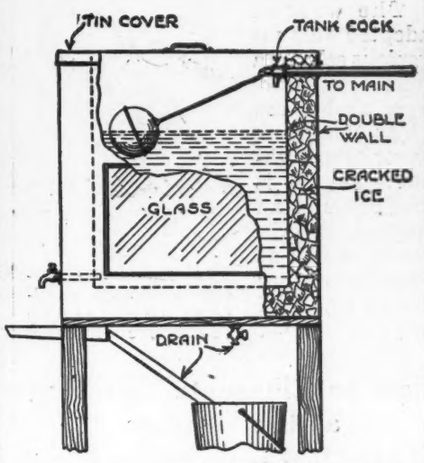
AFTER July 1st the ice-water tank will become even more popular than it has been heretofore. There are many contrivances of this sort on the market, but the one illustrated is easily made, even by those with little knowledge of tools, and it will do its work efficiently.



The water tank is entirely surrounded by cracked ice, practically setting the water in a bed of ice

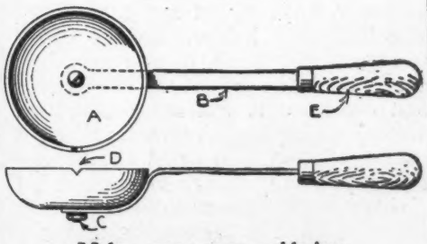
Two tin boxes are fitted one inside of the other, the ice being broken up and placed between them. A simple water trap valve controls the water level, which may be adjusted to any height desired, while a petcock in the bottom allows the water to be drained off after it has melted from the ice.

The tank can be made to look very clean and neat with a coating of white enamel and will repay its slight cost by keeping you cool and comfortable.—ROBERT SCHMITT.

A Handle Ladle Made from a Bell-Gong

AN excellent solder ladle can be made from an old bell-gong, a strip of brass, and a handle.

A is the gong, taken from an old electric bell. *B* is a strip of brass fastened to the gong with a small bolt, *E*. The dent *D* is made in the gong with a pair of pliers, so that the molten solder can be poured to a given place.—FERRON HIMES.



Make your own soldering ladle from an old bell-gong, a strip of brass, and a handle

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Attach a Screw-Eye to Your Key-Ring

DID you know that the ordinary screw-eye used by carpenters for fastening hooks, etc., is an excellent substitute for the corkscrew?

The writer adopted this ingenious scheme a number of years ago, and since that time has never been without one. It is invaluable as an emergency corkscrew, as well as a first aid in other mechanical ways.—R. GILL.

The ordinary screw-eye makes an excellent substitute for the corkscrew

How to Eliminate Sparking at the Brushes

SPARKING at the brushes in the operation of electrical machinery, especially D.C. machines, is a very common trouble. Faulty design or construction, and perhaps errors in assembling, are some of the causes; but the majority of cases may be classed as operating faults.

Of the purely electrical causes, the most common is the wrong position of the brushes. This may be due to the brush gear not being securely clamped and thus working around into the wrong position. Where a number of brush-holders are clamped on a single stud, alinement of the holders is essential for good commutation. Brush-holders out of line with the line of the commutator segments will also cause sparking.

Faulty field coils, due to ground or a partial short circuit, will also cause poor commutation. Re-insulation will be found necessary. A partial short circuit in one of the field coils may be found or located by noting which of the coils is the coolest.

The most frequent cause of sparking is overloading. With an ammeter in the circuit this can easily be noted. Overload sparks extend the entire width of the brushes. If the overload is increased, the sparks may cause a flash-over, that is, an arc extending from holder to holder. In the case of a motor the brush rigging may be burned and the armature damaged. In a generator it will act similar to short-circuiting the armature. Before starting the machine again the cause of the overload should be removed.

High or low commutator bars or high mica result in flashing and arcing, when not only the faulty bar but adjacent bars will become rough and blackened. High segments can be eliminated by turning or grinding the commutator. High mica can be cut off and recessed.

Dirty and oily commutators are also a common cause of sparking, and the remedy is obvious.

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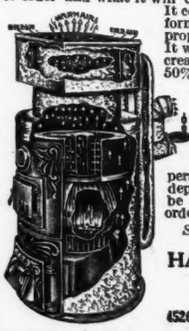

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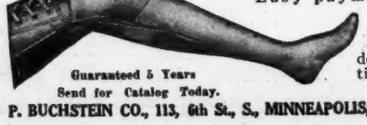

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FOR mystifying your audience the magic pointer is a "sure-fire hit." It is used in combination with a large clock dial having a center pin, which the pointer spins upon, and stopping at any number indicated. It tells the day of the week, the time of day, number on a card, etc., the numbers all being controlled by the clock's operator. The pointer works upon the gravity principle; that is, the lead weight *E* always comes to rest at the lowest point. Since the lead weight can be moved in a circle to different points, it is easily seen that the relation of the lead to the center of the pointer determines its position on the clock dial.

The performer is able to gage the pointer's stop by the action of spring *M* passing over a series of twelve holes

The performer spins the clock hand and demands it to stop at a certain numeral asked for by the audience. How does he do it?

in *B*. To start with, the pointer is set at a certain number, and if any other number is required all the performer does is to turn the center portion of the pointer over a required number of holes.

The actual making of the clock can best be understood by following the details set forth below. The parts are made from odds and ends of old material.

A is the pointer. It is filed down from $\frac{1}{32}$-in. sheet brass. The $\frac{1}{4}$-in. hole in its center must balance the pointer accurately.

B is a piece of $\frac{1}{32}$-in. sheet brass, equally spaced holes $1\frac{1}{8}$ in. from its center. This piece is sweated to *A*, as shown in the diagram, the $\frac{1}{4}$-in. holes, of course, being in line.

C is a curtain-rod end. Attached to *C* is the index spring *M* that revolves over the index circle *B*. The square hole fits over the square end of the spindle *L*. *D* is another curtain-rod

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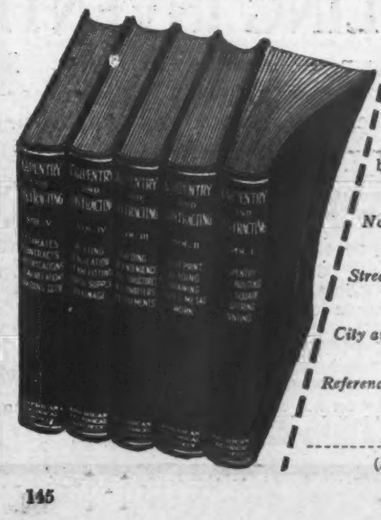

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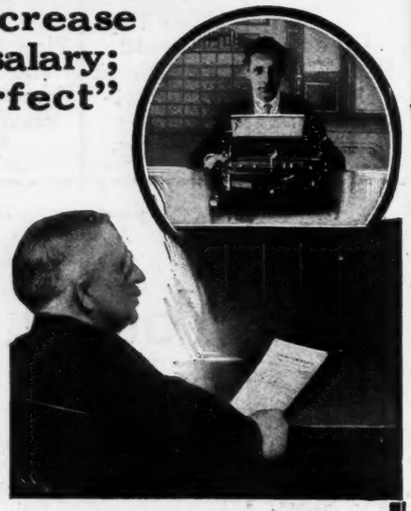

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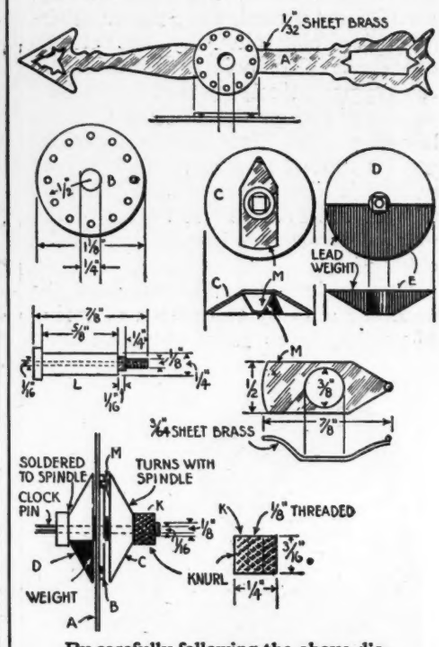
that contains the lead weight *E* held therein by shellac. *D* is soldered to the spindle *L*. *E* is the lead weight, this being made by first filling *D* with hot lead, which is removed and sawed in half after it has cooled. *K* is the knurled nut that holds *C* and *D* together on the pointer. *L* is the spindle made from 3/8-in. drill rod with



By carefully following the above diagram and the description in this article the clock dial and pointer can be easily made from odds and ends

a 1/16-in. hole in it that fits freely over the pin in the center of the clock dial.

On *L* under the thread portion is a square part that fits into the square hole in *C*. This is necessary in order that parts *C* and *D* will turn together on the pointer *A*. *M* is a brass spring that is soldered in *C* and acts as an indicator to the performer as he feels it pass over the holes in part *B*. The dimensions given can be changed to meet individual needs.

Experimenters and amateur mechanics will get a lot of pleasure in making and using this piece of mystery apparatus.—R. S. MYERS.

A Machine that Polishes Silverware at Home

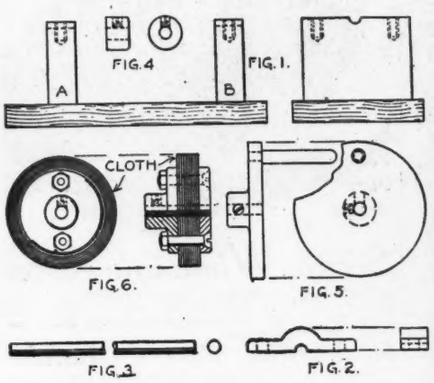
SHOULD the reader at some time or other decide that some of his household goods need a polish, why not at the same time decide to do the polishing himself?

Results make the work interesting, and to make a polishing machine good enough for such a purpose is an easy task.

The sketches accompanying this article explain fully the various parts and their functions.

First, refer to Fig. 1, which shows the base, consisting of two blocks of wood "A" and "B," each having a half hole as shown at end view. Then

comes the cap shown at Fig. 2. Of course there are two of these caps. At Fig. 3 is shown the spindle, and this is made either from a piece of

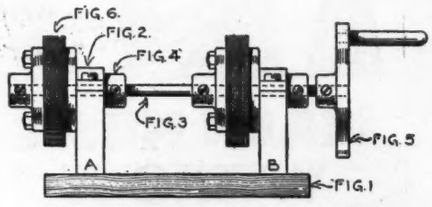


The figures in the illustrations above and below describe in detail the various parts from which the machine is made

pipe, as shown, or a piece of cold rolled steel if desired.

Four washers, as shown at Fig. 4, are used to take up the thrust of the spindle, and these can be made of wood or steel as desired.

The driving handle and disk shown at Fig. 5 does the necessary turning, and a treadle design in place of the



Silverware and brass are quickly polished with this home-made polisher

crank can be made if considerable work is to be done.

Last come the wheels. They are easily made in the manner shown at Fig. 6.

Assemble all of the parts, as shown in the lower diagram, and you have a homemade polishing-machine capable of good work.—J. W. MOORE.

Making a Wash Bottle for Test-Tube Cleaning

A WASH bottle, which is used in every chemical laboratory to clean test-tubes, can quickly be made from materials picked up about the laboratory. It consists of four parts: two lengths of glass tubing, a two-holed cork, and a bottle of any shape or size. One of the glass tubes should be from three to four inches longer than the bottle, the other about 5 in. long.

The longer tube must be bent near its top, as shown in the illustration, and the end of the shorter tube drawn out to a fine point. Both tubes are placed through the two-holed (rubber) stopper, so that the shorter tube extends about ½ in.

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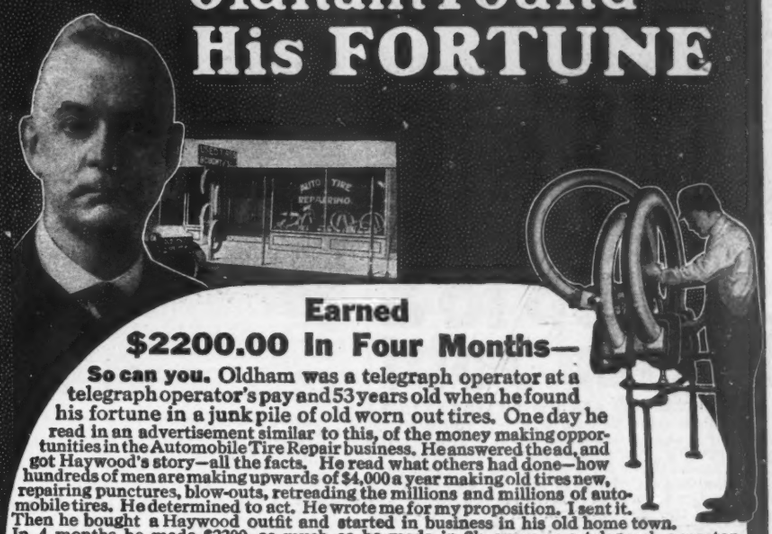

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So can you. Oldham was a telegraph operator at a telegraph operator's pay and 53 years old when he found his fortune in a junk pile of old worn out tires. One day he read in an advertisement similar to this, of the money making opportunities in the Automobile Tire Repair business. He answered the ad, and got Haywood's story—all the facts. He read what others had done—how hundreds of men are making upwards of $4,000 a year making old tires new, repairing punctures, blow-outs, retreading the millions and millions of automobile tires. He determined to act. He wrote me for my proposition. I sent it. Then he bought a Haywood outfit and started in business in his old home town. In 4 months he made $2200, as much as he made in 2½ years as a telegraph operator.

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You can do it, equally well or possibly better—Oldham's record of money making—It's being done every day; its facts within reach of every ambitious, determined man. If you are that calibre you will sit down now and write Haywood for full particulars. When you get all the information you want, you will jump at the opportunity. You will see an opportunity bigger by far than we can hope to tell you in the limited space of this magazine.

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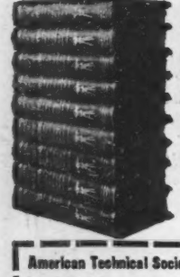

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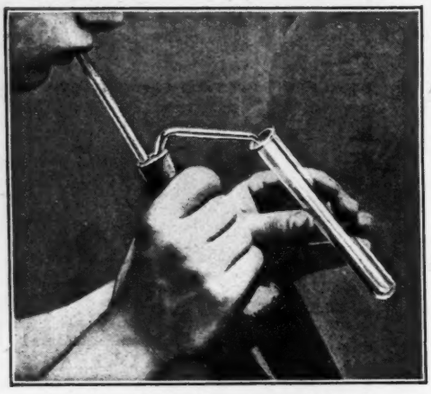
below the cork and the long tube, coming to within ½ in. of the bottom of the bottle. Now carefully draw out the cork with the glass tubes, fill the bottle with tap or distilled water, and replace the cork.

If a current of air is blown into the short tube, a fine spray will be



Here is a quick and sure way of cleaning test-tubes. Only a few minutes are consumed in making the apparatus

ejected from the nozzle. The force of the spray is strong enough to clean the majority of test-tubes. When only a few cubic centimeters of water are required, tilt the bottle and allow the water to run out of the shorter tube.—ERNEST BADE.

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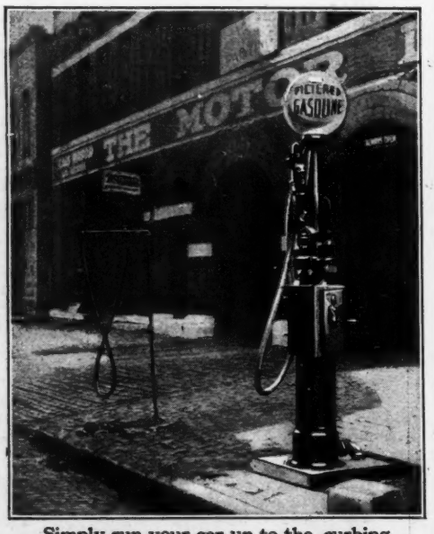
HERE is the novel way in which an enterprising garage-keeper supplies water for automobilists. Instead of the motorist having to go in-



Simply run your car up to the curbing and turn the water into the radiator

side and hunt up a can (the usual way), he here has the water handy at the end of a flexible hose.

Needless to say, this contrivance soon paid for itself by increased trade, for the simple reason that motorists stop their cars at the most convenient place for supplies.—DALE VAN HORN.

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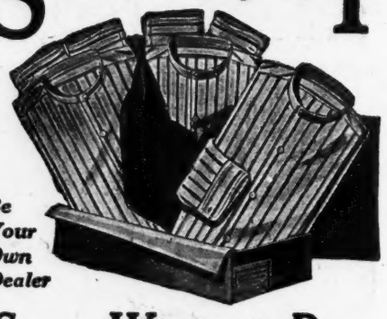

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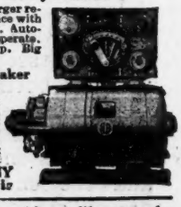

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A Tooth-Brush Makes a Good Drawing-Pen Cleaner

THERE is no better cleaner for the mechanical drawing-pen than a tooth-brush. For this purpose a ten-

A tooth-brush makes an excellent pen-cleaner, for it leaves no lint and does the job quickly and efficiently

cent one will do. The same plan applies to any kind of pen you may be cleaning.—J. W. MOORE.

How to Make a Card Dissolve into Water

A PLAYING card is taken from a deck, placed under a handkerchief, and then allowed to drop into a glass of water, where it disappears. A member of the "watch committee" performs the "dropping of the card," which adds further to the parlor mystery.

The feat is accomplished by having on the table a small piece of celluloid the exact size of a playing card. After a card has been chosen, it is placed face downward on the table, so that it will rest on top of its transparent

After placing the card beneath a handkerchief it is dropped into a glass of water, where it disappears

duplicate. Picking up celluloid and card together, they appear as one, since the face of the real card is distinctly seen through the transparent celluloid.

Under a handkerchief the real card is slipped up the performer's sleeve, while the celluloid duplicate is allowed to remain. It is this blank duplicate that the audience feel and see outlined beneath the folds of the kerchief, and of course in the water it cannot be detected.

The performer then quickly removes the card from his pocket, diverting the eyes of the spectators from the apparently empty tumbler—which can then be removed.—MERRITT HALE.

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Every Knock Is a Boost if You Use Your Ears

ONE of the most delicate problems the amateur motorist has to deal with is that of distinguishing between and locating various engine knocks. While there are numerous "listening" devices on the market, experience is, as usual, the best teacher, and will enable you to repair it before it develops into serious trouble. A few of the mysterious knocks are described below.

The more experience one has in listening to knocks, the more expert will one become in finding them and telling what is loose. Each faulty motor part has a different knock, which comes always in regular periods relatively to the speed of the engine.

Locating the Trouble

A loose connecting-rod produces a sharp bump or a very heavy hollow sound. It is easy to locate the faulty connecting-rod by running but one cylinder at a time, in which case two bumps are usually noticeable, due to the relief of the explosion pressure. If the rod is very loose the knocks can be located by turning the engine with the crank. This trouble is caused by a twisted rod, loose bearing, scored bearing, burnt-out bearing, or side play. With a seized or burnt-out bearing the motor will groan or stick in starting.

Pull up the engine hood every so often and listen carefully. A little practice will enable you to detect trouble

The main-bearing knocks are readily located by running two cylinders at a time, one on each side of the crank bearing. A hard bump will be noticeable throughout the motor, produced regularly with the firing of the two cylinders. Such knocks are caused by end play in the shaft, loosely fitting bearings, or scored or a burnt-out bearing. In the latter two instances the motor will groan upon starting cold.

A loose piston-pin is distinguished by a sharp metallic knock. It can be located by using the listening rod for each cylinder and speeding up the motor, then closing the throttle suddenly. By doing so a double knock will be noticeable, which is very sharp and better termed a rap. The knocks

are caused by a crooked or broken pin or by a tight or badly worn member.

A loose crank-shaft is seldom encountered. It gives a rattling slap combined with a thud. In some cases only the thud is audible; in other cases the looseness of the bearings will allow the gears to slap and rattle. Generally this trouble is very hard to discover, due to the pressure of the valve springs. The trouble can be located by sounding gear-case and cam-shaft bearings with the listening apparatus. The knocks are caused by loose bearings, end play, or badly fitting bearings.

A loose flywheel will produce a very heavy knock at low engine speed, and will appear regularly. The knock will change its nature entirely when the motor is speeded up, and the vibration of the shaft will produce a dull, chattering knock. It is located by disengaging the clutch and rocking the flywheel back and forth. The trouble is caused by improper fitting, loose bolts, broken bolts, or bad keys and splines.

To Discover a Loose Piston

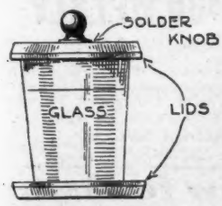
A loose piston gives a very short knock, its clearness varying with the size of the cylinder and metal used in the piston. It can be located very easily by the use of the listening apparatus against the cylinder wall. It is caused by a large bore, small piston, or taper piston or bore.

Loose valve tappets will produce a brisk tap or knock very often encountered, and difficult to remedy on a high-speed motor. This trouble is caused by an excessive clearance, bent or sticking valve stem, flat and out-of-round rollers, bent valve spring, or a seat that is not square, or a combination of causes.

Successful hunting for these troubles requires a great deal of experience that can be obtained only by continued practice, which develops the sense so that not only are the different knocks easily distinguished, but they are also speedily located.

To Make a Cover for the Medicine-Glass

TWO lids from "pry-top" cans can be put to excellent use by soldering a knob on one, as shown in the illustration, and then enameling both of them. The top with the knob acts as a dust-proof cover, while the



Make an attractive cover and tray for your drinking glass from tin can tops

other serves in the capacity of a tray to hold the glass. This is especially convenient for people who wake up in the night for a drink of water.—WILLIAM PAUL LANGREICH.

To cut down the cost per cut

Put on the Weight

If you're cutting with a medium or heavy power machine, start out with a good, full, 45-pound pressure after the first two or three strokes. As the number of cuts progresses, increase your weight. Remember that once the first keenness of the blade is gone, the heavier gauge of the blade the greater the pressure required to make the teeth "bite." Too little weight will ruin a blade almost as quickly as too much.

Follow the Starrett Hack Saw Chart in selecting your blades. Put on the weight and watch the cost per cut go down.

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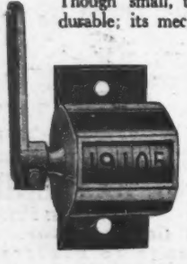
You can better size up the work-capacity of your machine by getting a running record of its *output*, under various conditions of mechanical adjustment and control.

Such records, put plainly before you by

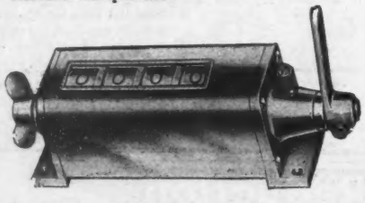
Veeder COUNTERS

give you the right idea of what to *expect* in amount of work, and help keep up what you find to be the *standard* production-rate for each machine.

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines, and most adaptable to experimental work. If run backward, the counter subtracts. Price, $2.00 *(Cut nearly full size.)*



The Set-Back Rotary Ratchet Counter below is for larger machines, such as punch presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.50. *(Cut less than ½ size.)*

There's a Veeder for every purpose where you could possibly use a counter. Write for the new counter booklet.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

Keep the Engine Clean and Prevent Fires

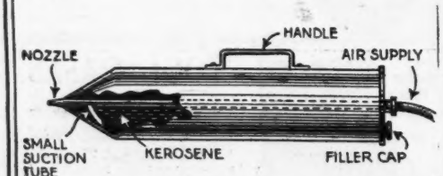
MOTORISTS usually pride themselves on keeping the car engine clean by giving it a bath in kerosene every so often; this is to remove the heavy grease deposits that accumulate on its exterior. To get

Where there are a number of automobile engines to clean, this contrivance is indispensable as both a time- and money-saver

into all the crevices, beneath the carburetor, and around the water-pump is almost impossible, for the brush used in the operation is much too large to permit this.

A gasoline or kerosene spray, under air pressure, will quickly remove grease and dirt from the engine of the chassis.

The contrivance that throws this spray is shown in the illustration,



As shown by the diagram, the cleaner is extremely easy and simple to make

being made at practically no cost, and will prove its weight in gold to the man who has much of this work to do.

A tank holds the liquid, and an aspirator is used for forming the spray. The aspirator is nothing more than a copper pipe which passes through the center of the tank, one end being connected to the air pressure line, and the other end being drawn down into a nozzle. A small copper tube connects this pipe, so that the cleaning solution is drawn from the tank and forced into a spray by the passing air. A foot pump can be used to inject air if no other pressure is available.

The foregoing proves that this cleaner is practical for quick work in either the public or home garage. It can be stowed away when not in use.—R. L. PRINDLE.

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How to Turn Accurate Gage Pieces

IN some kinds of work it is necessary to use accurate cylindrical pieces as gages for setting up parts in alinement. Since these pieces are of special sizes and often used only once or twice, grinding or other expensive methods of making could not be considered.

If a piece is ordinarily turned in a lathe by using a dog on either end,

How to eliminate expensive methods and still be able to turn out accurate gage pieces

chucking one end, etc., certain small inaccuracies are bound to result. Accordingly, drill a hole in one end and force a pin in it to act as a dog. In this manner the piece is produced entirely on center and at one setting, besides resulting in absolute accuracy.—S. B. ROYAL.

A One-Man Sack-Filling Contrivance

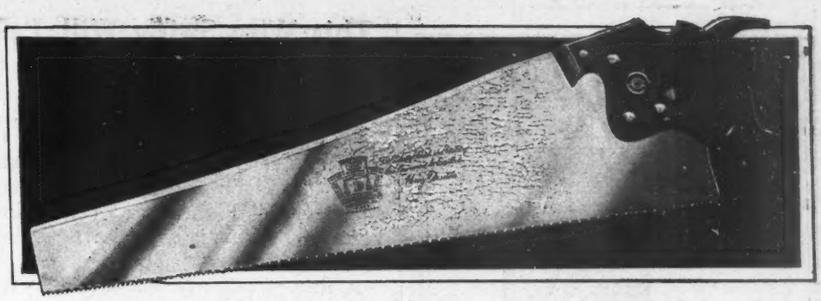
THIS device for holding sacks while filling them should save backache and many useless adjectives.

It is made of half a pickle-barrel with the ends knocked out, attached by a small block of wood to the side of a bin or granary.

Five or six nails, driven through the sides of the barrel from the inside and pointing at an upward angle when the

With this arrangement for holding the sack, one man can do the work of two in filling

barrel is in place, hold the sack in place during the filling. The sack is pulled up over the bottom of the barrel as shown. It should be at the right height from the floor for filling, at the same time resting on the floor to prevent strain on the nails and tearing the sack.—DALE VAN HORN.



"Son, this saw is part of your education—

"It will give you the practical experience you need to develop the talent that's in you.

"Another thing, son—this saw is balanced, sharpened and set as accurately as a delicate instrument is adjusted. And with proper care it will stay that way.

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A Disston Saw develops initiative, resourcefulness, and creative ability. It cuts so clean, so fast, so true that its use is a constant inspiration toward good work.

Disston Hand Saws are made in various styles—a saw to meet each specific requirement. Sold by dependable dealers everywhere.

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Red Devil Pliers speed the work. They are made to stand years of hard service, and they are strong enough to do work pliers are seldom called upon to do.

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Properly designed pliers are particularly handy. You can use them as you use your fingers when you work.

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This Wire Swing Will Last for Years

WHEN the ordinary swing is made from rope and attached to the limb of a tree or some other high support, it will be noticed that the seat sometimes is high and at other times very low. This is due to atmospheric conditions.

A fine substitute for the rope is a galvanized wire, such as is used by linemen for guying-poles. This, however, cannot be wrapped around the tree limb like a rope, as the constant

The wire swing is not affected by atmospheric conditions as is the old-time rope swing

bending back and forth would soon break it off.

Obtain a pair of heavy barn-door hinges; fasten one end to the tree, then attach the wire to the other end of the hinges, as shown in the illustration. An occasional oiling or greasing will make the swing last for years and withstand the elements as a rope swing would not.—VICTOR H. TODD.

An Automatic Drinking-Cup for Poultry

FIVE or six times a day the pail containing the chickens' drinking water must be refilled. But why not simplify the task and supply the drinking water from a reservoir that automatically regulates the flow of water?

This automatic drinking-cup consists of three simple parts: a small but deep enamel dish, a bottle, and a support. The support consists of a board 8 in. wide and one third longer than the bottle. The lower part of the board receives a small shelf slightly larger than the cup that is placed upon it. Then the bottle is laid upon the board and two strips of tin are so nailed to it that they will hold the bottle in the position shown in the photograph. The support can now be attached to the chicken-house,

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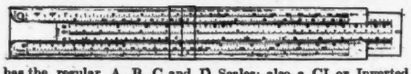

has the regular A, B, C and D Scales: also a CI or Inverted Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from engine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10 inches. A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order.

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the cup being two or three inches above the ground.

When the bottle has been filled with water it is quickly inverted over the cup. Water will run out of the bottle

If you use this contrivance in the hen-yard your poultry will never be thirsty; it refills automatically.

until the surface just touches the neck. The water used is replaced by fresh water running out of the bottle. The bottle need be refilled only when it is empty.

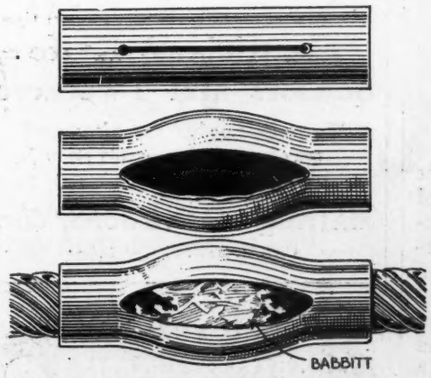
As can be seen from the illustration, the chicken cannot stand upon the water-pan and overturn it, for it is set against its stand in such a way as to prevent this.—ERNEST BADE.

How to Install a Cable on an Elevator

WHILE installing a new operating cable on an elevator, I found that a short piece had been spliced in and had simply been tied in several bulky knots.

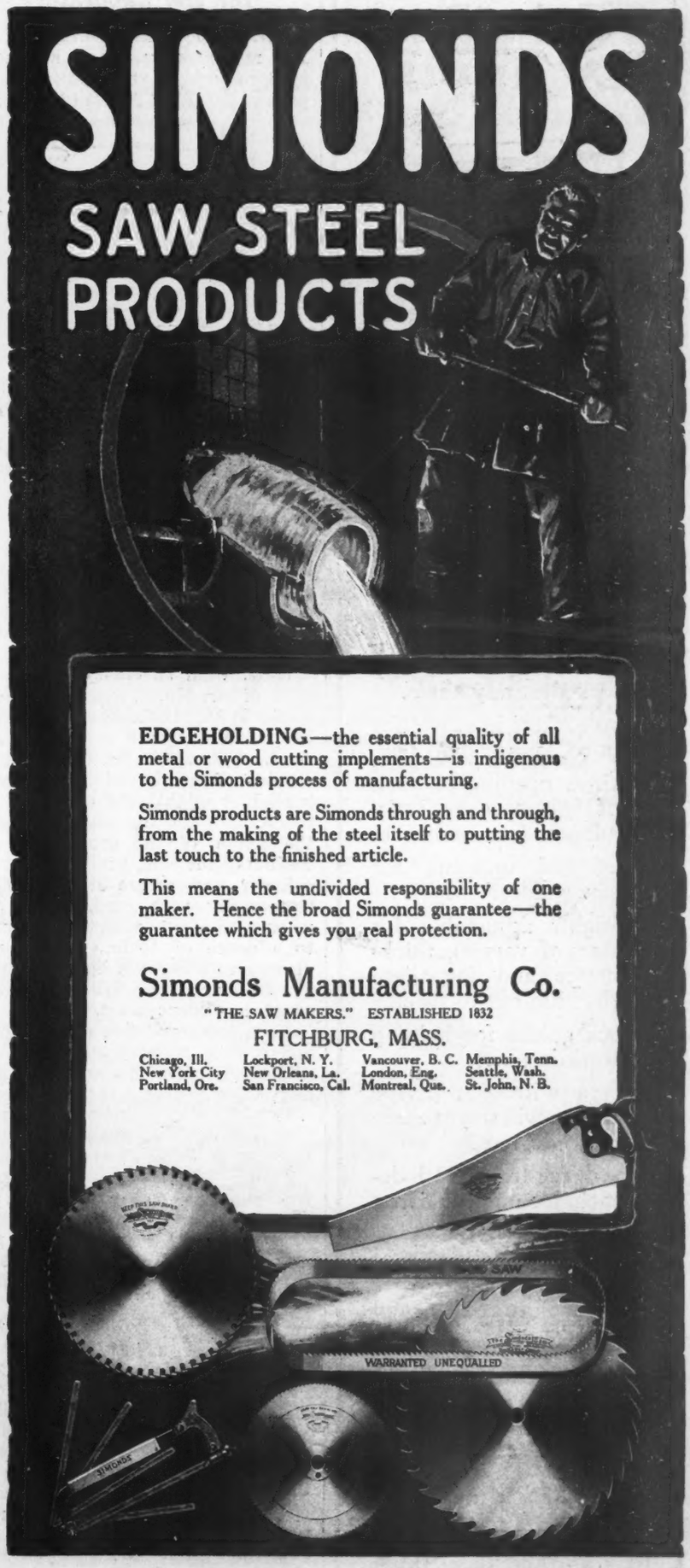
Slipshod work of this kind is the reason why many accidents happen in the large mills and factories throughout the country.

A better and more workmanlike way to do this job would have been to use a piece of pipe about 8 in. long and



Make a neat splice in the elevator cable in the manner here indicated

of a diameter large enough to allow the cable to enter easily. Slit the pipe for about 4 in., and spread the halves with a chisel, as shown in the illustration. Place the ends of the cable in the ends of the pipe, spread the strands, pour in hot babbitt and the job is finished.—ERNEST SCHWARTZ.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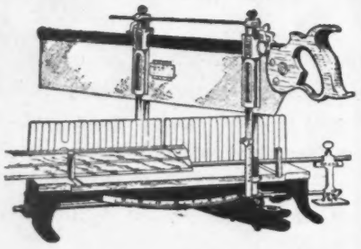
Stanley Tools



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A Few Striking Features

Saw is held above work when not in use.

Swivel is automatically locked at any angle.

Two sockets in swivel for use of long or short saw.

Narrow opening in back of frame, especially adapted for small work.

Steel rod uprights for saw guides.

Uprights adjustable for saws of varying thicknesses and for those that run out of true.

Stock guides for holding work in place.

Extra wide range for work—will saw at angle of 30 degrees.

One-Piece frame with detachable malleable iron legs.

Construction thoroughly mechanical; all parts interchangeable and readily replaced if lost.

Quickly and easily put together or taken apart for carrying.

A specially made back saw furnished with each box

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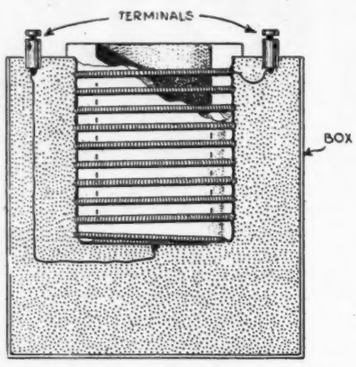
Making an Electric Furnace for the Laboratory

A SMALL electric furnace of the resistance type, much superior in most respects to the arc furnace and possessing a high degree of efficiency,

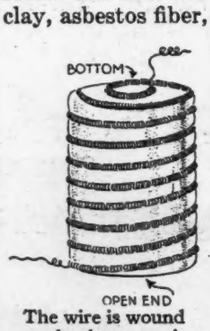


A cutaway view of the electric furnace—a contrivance that will be a valuable addition to any laboratory

will be found exceedingly useful in the laboratory. To make it, secure a corrugated Alundum core 2½ in. deep and 2 in. in diameter. Hollow cores, open at one end and closed at the other, can be obtained for this purpose.

Next, wind as closely as possible 42 ft. of bare No. 20 resistance wire on a spindle 3/32 in. in diameter, leaving one ft. free at each end for connections. This will be better if machine-wound. When the coil has set, stretch it slightly so that the turns will not touch, and, starting with one end at the center of the grooves on the bottom of the core, wind it about the cylinder and secure it in position temporarily with cord. Cover the whole with a layer of Alundum cement to a depth of ⅛ in., and connect directly to a 110-volt lighting circuit. The heat developed will very quickly cause the cement to set.

Now, for prevention of heat losses and greater convenience in use, insulate this unit with a mixture of fire-clay, asbestos fiber, and water-glass as follows: Secure or make a cubical box about 5 in. on an edge, and pack in the bottom of it a doughy mass of the above mixture, using water-glass in the form of a solution. Set the heating unit in the center and just flush with the top, bringing the free ends of the wire out for connections. Then pack the mixture about it firmly, making a smooth, even surface on the top. Make a tightly fitting cover of the same material, and fill the cavities of both with a cement of fire-clay and water-glass. With the cover in place, turn on the current, and when thoroughly dry and hardened break



The wire is wound as closely as possible on the spindle

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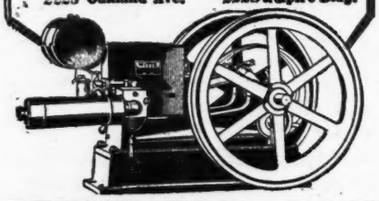

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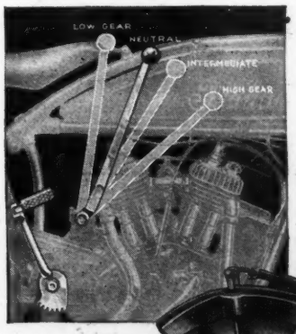

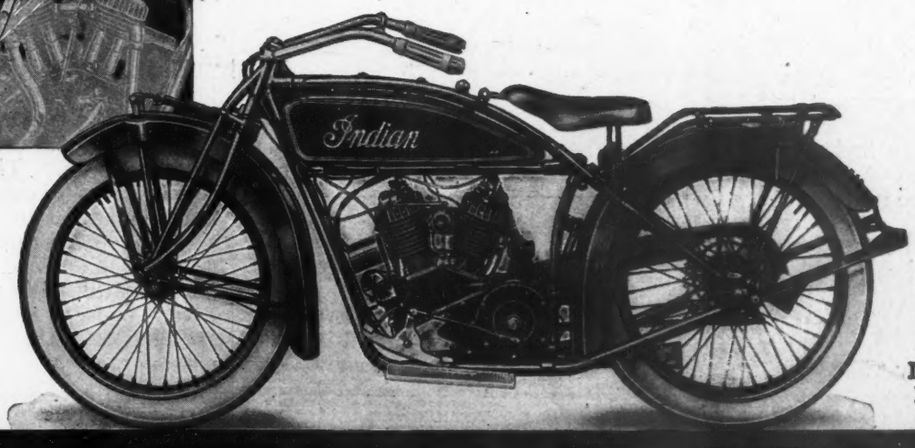

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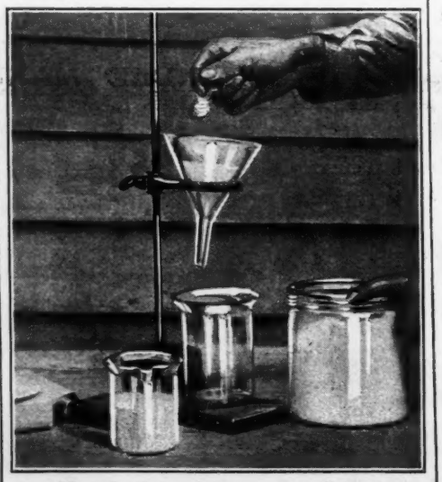
away the box and retouch the surface with the fire-clay and water-glass cement. The ends of the wire may be secured to binding-posts set in the cement, if desired.

Such a furnace as this may be made at very small cost, and it will serve as well as a bought furnace for which you would pay a considerable sum. In it precipitates may be ignited, fusions made, and alloys melted. It will give a temperature of 1,000° C. for an indefinite period or 1,200° C. for a short time. By means of a suitable resistance in series with the furnace any desired temperature may be obtained, and for prolonged use such a resistance will be essential. The capacity of the furnace is such that it will take crucibles of several sizes.—FLOYD L. DARROW.

Separating Water from Oil by Filtration

TO separate large quantities of water from oil, first let the liquid stand for twenty-four hours, at the end of which time all the oil will be floating on top, and then use a separatory funnel. If the oil and the water



Here is the way to separate oil from water. A funnel, filter paper and a container are all that is necessary.

do not separate easily, a few cubic centimeters of benzol stirred into the liquid will accomplish your object. The benzol can be removed by distilling over a water bath.

Sometimes, when there is only a small quantity of water intimately mixed with the oil, the water and oil will not separate, no matter how long the liquid is left standing. In such cases water must be removed by filtration. The filter paper is placed in the funnel in the usual way, and the paper is filled with common table salt. Now the liquid is poured on the salt until all of the oil has filtered. The salt is not dissolved by the oil, and there is not enough moisture present in such a solution to dissolve it, but it absorbs the moisture and allows the oil to drain through thoroughly dry.—ERNEST BADE.

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